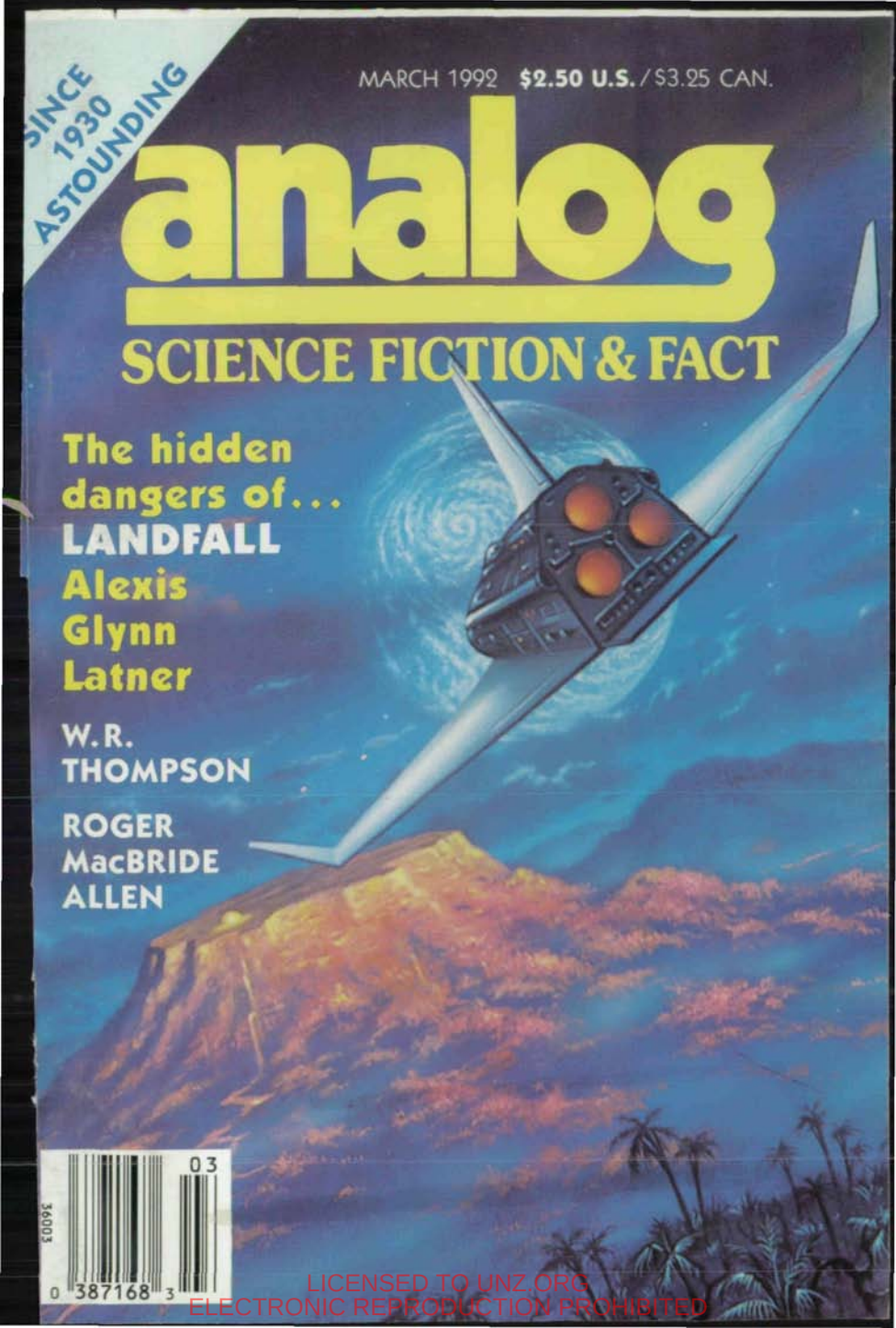

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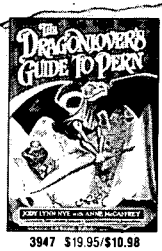

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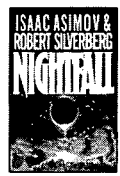

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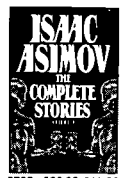

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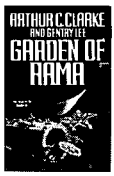

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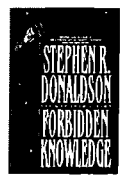

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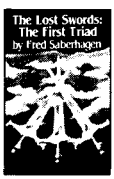

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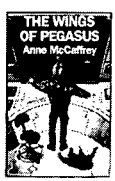

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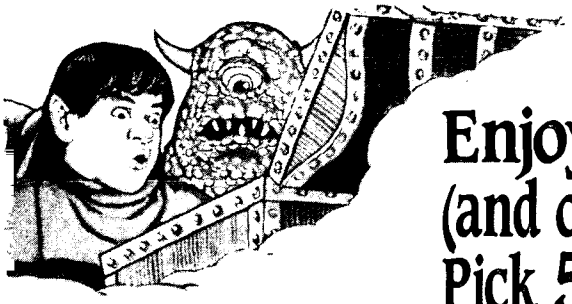

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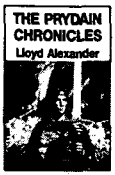

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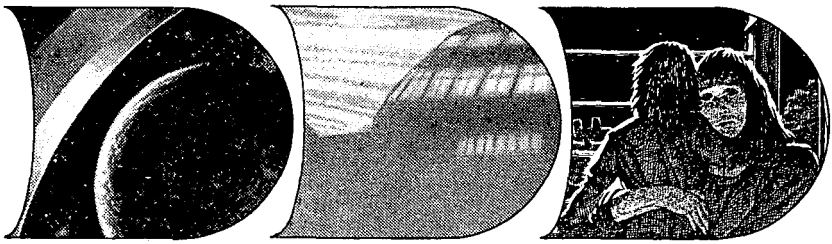

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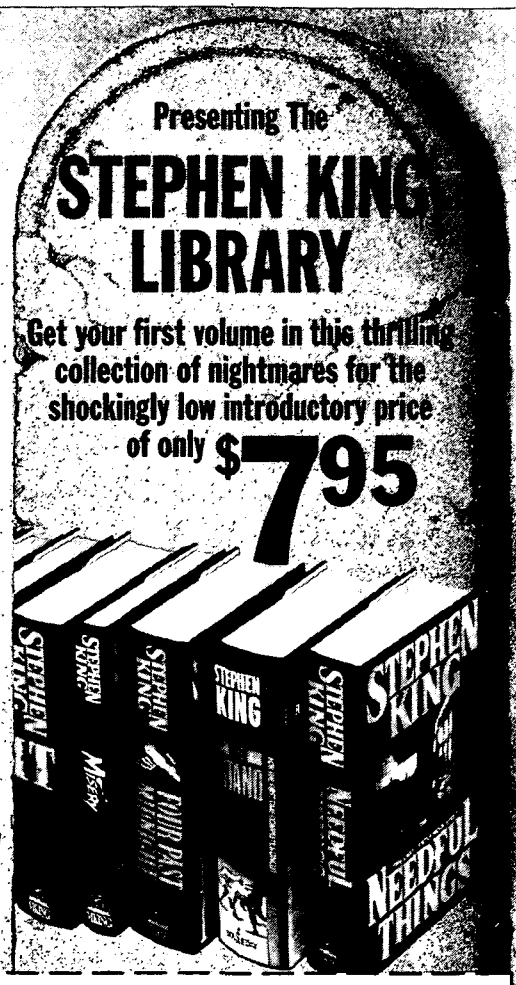

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Guest Editorial

WORDS OF PROMISE

Reginald Bretnor

At a time of anxiety and fear, when we and our world are in very real peril, there is the ever-present temptation for politicians and statesmen to offer us words rather than realities. Words which do not correspond to the socio/psychological structure of the real world, but which very plausibly *seem* to. Of course, this has been with us always, especially since the Industrial Revolution with its disturbing changes and frightening weapons developments. However, in just this century it has been alarmingly intensified to the point where very real problems crying for very real solutions elicit virtually nothing but words which, promising solutions, actually perpetuate and, indeed, exacerbate the problems they pretend to solve.

Two salient examples of these words of promise today are *disarmament* (or *arms control*) on the international scene, and its corresponding idiocy, *gun control*, on the domestic. They share the same basic false premises and produce exactly the same sort of results—the very opposite of what they promise.

First, *arms control, disarmament.* Here we have the perfect simplistic argument: *Weapons are engines of death and destruction. Ergo, eliminate them or control their numbers and the dove of peace will coo hosannas.* Yes? Well, consider the history of disarmament since Czar Nicholas convened the first Disarmament Conference at the Hague in 1895. How many more conferences have been held? How many solemn treaties have been signed? How many promissory speeches have been made before the League of Nations, the

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United Nations, legislative bodies, academic senates, women's clubs? How many thousands of books and articles have been published on the subject? *And what has all this accomplished*?

We have—wonder of wonders!—outlawed the dumdum bullet, and as I write our tin-pot Hitlers, like Saddam Hussein, are busily acquiring superweapons.

In 1969, in an article published in the *Michigan Quarterly Review* ("Disarmament: Deadend and Detour") I pointed out that "weapons" are simply instruments of power, that many such instruments generally thought of as peacefully civilian can become weapons overnight—(a bottle of gasoline, for example, needs only a burning rag to become a Molotov Cocktail)—and so it is literally impossible to disarm a technological society *even if it wants to be disarmed*.

I also suggested possible ways of circumventing the fatal flaws in the disarmament approach to the achievement of a stable peace: strict conditions for membership in the United Nations, for instance, one of which would be that every member nation renounce the making of war *in its own constitution*. A means already proven effective, for no nation doing so—notably Switzerland and Uruguay and, since the Occupation, Japan—has ever made war. Another measure might be a limited world citizenship for men and women of good will and outstanding accomplishment, who could act to some extent as a world senate, an influence for balance in our precariously balanced anarchy of nations. Inevitably, some sacrifice of absolute sovereignty would be entailed, but is that not implicit in our acceptance of international law?

After the break-up of the great empires, primarily the British and the French (to say nothing of the earlier break-up of the Spanish empire in Latin America), all in the sacred name of another great word of promise—democracy—we succeeded in creating a madman's paradise. We have seen the bloody result of this in Africa, in the Indian subcontinent, in South East Asia, and South America, and as it now threatens us in Eastern Europe. After all, the small quarreling nations of the Balkans were known as the cockpit of Europe; and now—not satisfied with Balkanizing the entire world—we are giving it superweapons, which will in-

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evitably become cheaper and cheaper, simpler and quicker to manufacture, and more powerful. Is the answer to make more futile gestures toward "disarmament"? It is not. It is in the institution, in the society of nations, of strictures similar to those any sane nation imposes on the individuals who compose it—and which they, if they are sane, accept as essential to civilized existence.

No sane community grants an individual the right to use weapons against other men except in self-defense—the defense of person, property, and freedom. (Hunting and competitive shooting do not enter into it.) And any sane community punishes the criminal use of weapons swiftly and with certainty. Yet the community of nations, today, denies no nation—and that means, simply, the men who lead it, no matter how fanatical or how insane they may be—this right. The penalty for making war, for aggression, should be swift, certain, and automatically imposed—and it most certainly is not. Ideally, it should be imposed by authority of the United Nations, as it was in Korea and in the Gulf War, and if the present United Nations Organization ultimately proves to be little more than a playpen for savages—as it has so often seemed to be—by some more realistic successor world organization.

Disarmament, as we have seen, is not the answer—because it is literally *impossible*.

The answer is to create a sane environment in which the incentive *not* to misuse weapons is high and the penalty for misusing them so certain and drastic that it creates an incentive *not* to use them.

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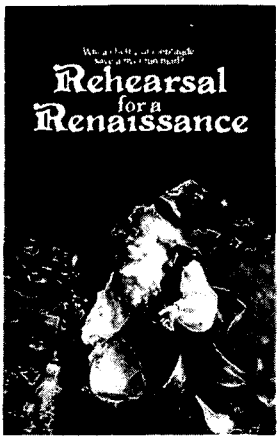

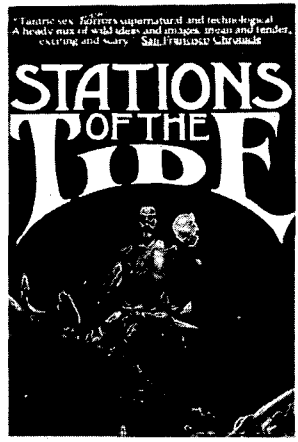
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The same rules applies to that aspect of disarmament labeled by its proponents as "gun control." These are words of promise as empty of realistic meaning as "disarmament" is in international affairs. The promise, again, is ridiculously simplistic and is invariably supported by false arguments. For instance, advocates of "gun control" always point to the low murder rate in Japan and Britain, where the civilian population is effectively disarmed, but never to the even lower murder rate in Switzerland and Israel, where the population is armed to the teeth. Nor do they mention the interesting fact that American Japanese, generally free to buy all the guns they want, have a lower murder rate than the gunless Japanese in Japan. And of course they ignore the demonstrated and, indeed, precisely measurable influence of the mass media, and TV especially, on the murder rate and on violent crime generally![1]

Simplistic solutions to complex problems are always tempting. They entail no thought; they delude many people into believing that the complexities do not exist. Take guns away from everybody except the armed forces and the police, and presto! You have instant tranquility. You do not even have to worry about the temptations a monopoly of force can offer any body of police or military who know that they can be opposed only by a safely disarmed citizenry. The Founding Fathers were quite sure that it *could* happen here. "The great object," said Patrick Henry, "is that every man be armed . . . Everyone who is able to have a gun." And James Madison, author of the Second Amendment, noted in the *Federalist Papers* that America had "the advantage of being armed" in contradistinction to those "governments which are afraid to trust the people with arms." Others of their contemporaries stated explicitly that the rights guaranteed in the Bill of Rights were *individual* not vague rights pertaining only to an abstraction called "society."

Our anti-gun luminaries today *never* quote any 18th century source for their contention that the Second Amendment grants only the right of an organized militia to bear arms. They cannot—simply because no such source exists.

In short, we are left with the choice of believing Madison and Jefferson, Washington and Patrick Henry, or such authorities as Senator Metzenbaum and the Hero of Chappaquiddick, and the gossip columnists and "celebrities" of the mass news/entertainment media. As a matter of fact, the Second Amendment does not grant anybody the right to bear and possess arms; by stating that this right shall not be *infringed*, it *affirms*

[1] The reader is referred to monographs by Bryan S. Centerwall, M.D., M.P.H., of the Departments of Epidemiology and Psychiatry at the University of Washington, "Exposure to Television as a Cause of Violence" and "Exposure to Television as a Risk Factor for Violence," published respectively in *Public Communication and Behavior*, Vol. 2, and *The American Journal of Epidermiology*, April 1989. Using the United States, Canada and South Africa as criteria, Dr. Centerwall showed that about eight years after the introduction of TV the murder rate soared. It happened both in the United States and Canada, and it happened eight or ten years after TV was introduced to South Africa in 1975. The conclusion was that TV violence has its most profound effect on pre-adolescent children, primarily boys, and that this erupts into actual violence in late adolescence or early adulthood.

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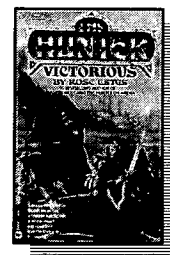

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its prior existence—in English Common Law and in the consititutions of several of the states.

It has been contended that as the gap between the citizen's weapons and any government's is much wider than it was in the 18th century, technology has made the question of the right to bear and possess arms academic. It has not. Arms in the hands of citizenry are a potent deterrant to crime, and the record of the various resistance movements in World War II shows their value against an enemy. Civilian arms pose no threat of tyranny imposed, not as military arms can and often have, but they can be an effective insurance against its imposition. Of course, privately owned weapons will be of little avail if the will to resist tyranny is lacking, but without those weapons no matter how strong, how unbending that will may be, it'll be worthless. (Please don't shout *satyagraha* at me. It worked against the civilized British. But how would it have fared against the Germans under Hitler, the Soviets under Stalin? Why has the government of India never employed it against the Pakistanis, the Chinese, the Sikhs?)

But let's return to the question of "gun control" and its promise where crime is concerned. It has never worked. It has never even appeared to work except in societies which already had a very low violent crime rate. (Thus, as Colin Greenwood, retired superintendent of the Yorkshire Metropolitan Police who spent a year at Cambridge researching the problem, has pointed out, the British murder and violent crime rate, low for many years, has actually risen since oppressive "gun control" laws were enacted.) And this holds true also for every high crime country and community where such laws have been imposed—Northern Ireland, Lebanon, New York, Washington D.C. It will be interesting—and sad—to see what happens now in those areas which fall for the current wave of "gun control" hysteria, California as a prime example.

What deterrents to violent crime do we presently employ? The threat of imprisonment and, where "juveniles" are concerned, often not even that.

Consider a hypothetical case—an only too common one. The offender has committed one or more hideous crimes against the person or persons of his fellow citizen or citizens—Charles Manson is an excellent example. Let's say rape in several modes, perhaps torture, culminating in cold-blooded murder. After months or years of appeals—usually paid for by the taxpayer—he is, at the worst, sentenced to life imprisonment *and the taxpayer is sentenced to support him* until he dies or is paroled. The cost at present probably runs from thirty thousand a year up. If he was solvent to begin with, his lawyers have bankrupted him and his dependents. If he was destitute, the state has paid his legal fees. Then, at a time when great numbers of Americans have *no* medical coverage because they can't afford it, he will have life-long care at the taxpayers' expense.

Why?

Recently, here in Oregon, I read of a

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small boy who needed a bone marrow transplant. The price demanded by our Dedicated Men In White was $180,000. His family couldn't raise it. He died. A few days later, in the same paper, I read of a felon, wounded in a shootout with the police, who was flown from Southern Oregon to Portland for medical treatment, again presumably at the taxpayers' expense.

How crazy can we get?

What would happen if anyone injured in the commission of a crime of violence, or of any crime involving the threat of a deadly weapon, knew in advance that the state would foot *no* bills for his treatment. Would that not be a powerful deterrent?

Brutal? No more so than allowing a kid to die for lack of money.

Let us suppose, too, that a law was enacted requiring all judges and all our legislators to walk to work, and forbidding them to be accompanied by armed guards (a la Teddy Kennedy?) Some very practical laws for the suppression of crime and the punishment of criminals would be passed.

Finally, how about a law forbidding any court to entertain any suit for damages filed by a convicted criminal for injuries suffered in the commission of any violent crime. Where violent crime is concerned no force necessary for its prevention or for the apprehension of the criminal should be considered excessive.

Such measures would be more than empty words of promise. Even if they were not as stringent as I have suggested here, they would result in what our anti-gun advocates tell us is their object: fewer murders and less violent crime generally.

Returning to those empty words of promise, "gun control," we would do well to remember that most crimes of violence are commited with weapons other than firearms—knives, assorted blunt instruments, and—thank God the idiot media haven't chosen to make much of this—with gasoline bombs and other incendiaries.

Ask yourself one question. Does a man or woman, especially one who can neither run fast enough to escape nor has the strength to handle an attacker, have the right to defend his or her self? Federal courts in that paragon of democracy, Washington, D.C., have ruled that he or she does *not*, that the police are there to protect them—and they have also ruled that the police have no duty to protect the individual, that their duty is to protect "society." In other words, their duty is to pick up the pieces (if they can even get there in time to do that).

What is at the root of all this muddled thinking? It is, essentially, fear—fear so pervasive that most of us scarcely are aware of its existence. We *feel* the constantly increasing perils confronting us: the danger of proliferating superweapons, the dangers of a society allowing itself to rot, to discard almost all rules designed to preserve balanced human relationships.

We are at least subconsciously aware of all this, and because we are afraid, we also fear to confront the real problems of maintaining peace in the world

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and safety in our streets. In such a situation, almost all men grasp for simplistic solutions, with little or no bearing on reality. After World War I, our own press made much of the "fact" that most of the crowned heads of Europe, whose wars men had allegedly been fighting for centuries, had been toppled from power, and that we could, therefore, look forward to a paradise of democracy and peace. All we needed was a gaggle of treaties and disarmament conferences. Similarly, today, we are being informed that "gun control" laws can restore, to our streets and cities, the safety they enjoyed before any gun control laws at all were passed.

In this situation, we are especially vulnerable to the leaders and would-be leaders, to the molders and manipulators of public opinion to whose interest it is *not* to find any real solutions. Consciously or subconsciously, men tend to work in their own interests. It is not in the interest of men like Saddam Hussein to work for a world at peace; and where matters domestic are concerned, we would do well to remember that it is not the criminial alone who profits by an increasingly criminalized society. ■

CORRECTION

● We apologize for this oversight, but Mary Caraker's "Taboos," which appeared in the January 1992 issue, should be listed as a Short Story rather than a Novelette.

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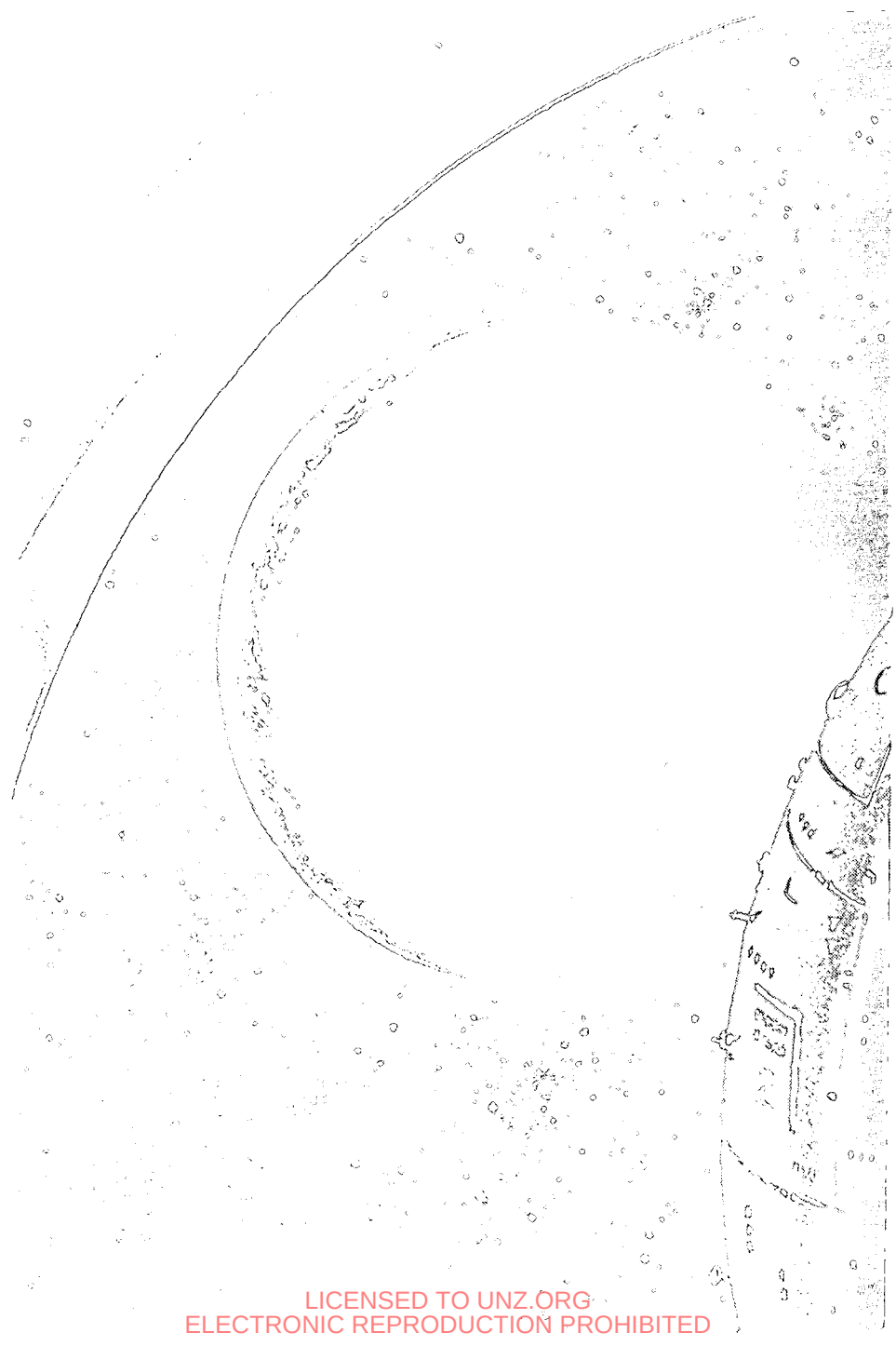

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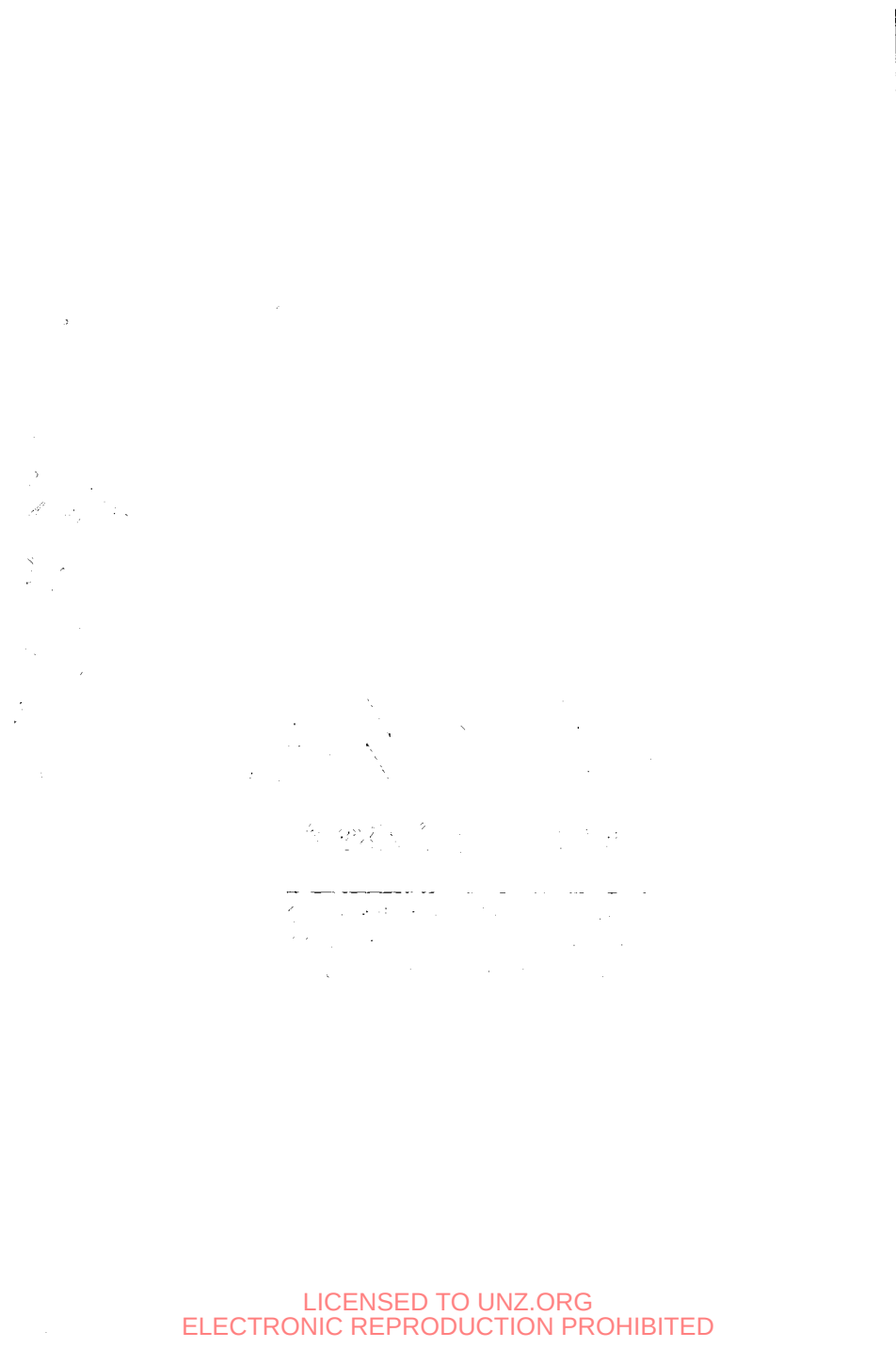

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Three. Two. One. Zero. The Earth shrank as Joe Norden watched through a window in a starship's hull, thick glass and a steel-walled hole as deep as a well. And Joe knew with wrenching finality that he would never see Earth again. The ship had begun its long journey, and he with it, never to return to the home planet.

Earth dwindled to a gleaming disk, a silver coin in a well full of stars. Joe wished for a new planet on the other side of stars and stasis.

Zero stayed. Cold and timeless zero, silent, insensate nothingness went on and on.

Until now.

"One." The voice was hoarse, cracked, and his own. "Two. Three."

"Good," said the tall blonde woman. "What comes after three?"

A hissing tinnitus in his ears sounded like a spring thaw, a rushing melt of blood in his brain. It distracted him.

"Come on. Count to ten. Please, Joe," The woman sounded very worried.

"Four. Five."

Behind her, above a doorway, he saw: 3, 2, 1, 0. He studied the numbers with great interest. "Four, three, two, one, zero. Breakaway from Earth orbit."

"How do you feel?"

Homesick. Sick, remembering that the home planet was as good as gone for him. "Hung over." Joe made a weak attempt at a grin.

"Well, that's the right idea." She spoke softly and clearly. "Your body is steeped in exotic chemicals. The chemicals kept your body fluids from freezing—crystallizing and destroying your tissues—while you were in stasis."

"I know. You put me to sleep, doctor, once upon a time."

"Yes. A very long time ago."

"Time enough to cross the stars to a new planet?"

She nodded.

Overwhelmed, he put his face in his hands and said, "Christalmighty." She reached for his pulse, but instead Joe grasped her hand. Her skin felt warmer than his. "The terraforming—what stage?" he demanded.

"It hasn't begun," she said tersely. "We woke you up early, because we need you now."

He sat up straight. "I'm ready. Where to?"

"How do you feel?"

"I said where to, Catharin."

"Let's see if you can walk, or if I'll have to call for a wheelchair." She helped him to stand up, then shamble back and forth alongside the rumpled bed. The bed was labeled TORONTO, J. "All right, Joe, I think you can make it to the assembly room. Let's go out into the corridor."

Joe steadied himself with one hand on Catharin's shoulder. His legs cooperated, but his whole torso felt as though it were stuffed with cold stiff cotton. She guided him along the corridor—it curved upward, making him think that he was walking uphill—then into a room full of people. Their voices surged around his ears and seemed to smell of coffee. He let himself be helped into a chair beside a table. Then she left. He felt lost.

Another man was sitting at the table with him—a youngish Asian, who drank tea, one deliberate sip after an-

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other, while studying him sidelong. So he stared back. The Asian finally said, "Good morning, Mr.—?"

Joe went blank for the duration of three sips while he groped for an answer, his mind as dim and disordered as an abandoned warehouse, until he found the item that he wanted. "Toronto. Joe Toronto. First Tier."

Asian eyebrows arched up. "I take it that you renamed."

"You didn't?"

"For a Chinese individual, San Francisco is too long a surname. Mine is Wing. I am Carlton Wing, of the Sixth Tier. Most of those here," Wing added, "are Vanguard."

Joe recognized some of them. Recognition came too easily. They looked the same as before. According to the mission plan, the Vanguard should have aged by a decade, begun remaking a new planet, reestablishing civilization, while he still slept. And the Sixth Tier was supposed to have stayed in stasis for a century longer than the First. Joe Toronto felt confused and disliked the feeling. "Sixth?" he asked sharply.

Wing pointed over Toronto's shoulder, to a deep window low on the wall.

Long ago, in just such a window-well, Joe had watched Earth shrink as the starship accelerated. Now, as the ship rotated in space, a new world slipped into view: a cloud-glazed, blue world with alien green continents.

"I am a field botanist," said Wing. "They revived me before my time when they saw the abundance of plants down there!"

Catharin returned with a glass of pinkish water. Finding his grip weak, she wrapped both of Joe's hands around the glass. Joe sputtered, "That planet's too green!" Belatedly, he noticed that he had become the center of attention in the room. People clustered around his table.

"So it is." said Catharin. "That's why we had to revive you, among others."

Several agitated voices said, "It's a complex ecosystem!"

"Jungles . . . "

" . . . insects . . . "

"—microorganisms!"

Catharin continued, "We, by which I mean the Vanguard, quickly realized that we were lucky enough to have one of Earth's most distinguished biologists on the ship."

Joe heard a murmer of assent, someone whispering about the Nobel prize. Meanwhile, the Asian eyebrows arched again. "I did not recognize you, Dr. Nord—Toronto," Wing murmured.

"We revived you out of sequence," Catharin repeated quietly, making sure he got the picture. "Would you be willing to chair an advisory committee to assess the biological hazards involved in colonizing that planet?"

Joe began nodding before she finished speaking. "That's what we're all here for," he said. "To do what has to be done to colonize the target."

Wing said softly, "This is not the target planet."

"Huh?"

"We don't know all that went wrong." Catharin gimaced. "The ship traveled to the destination star, and the stasis machines revived the astronaut crew—myself, Captain Bixby and Commander Atlanta—as scheduled. The target world *was not there*. We re-

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programmed the autopilot, changed course, and put ourselves back into stasis. And the ship went on and on until the autopilot found this world."

Before he could ask questions, she pushed the glass in his hands up to his lips. "Now drink!"

Commander Atlanta was leaning against a table behind Catharin. Toronto recognized him, a tall black man. The starship's second-in-command. "We programmed the autopilot to search for a world with some green on it," said Atlanta. "Primitive plant life, enough to where there'd be oxygen in the atmosphere." He glanced at the world now spinning out of sight beyond the window and shook his head in amazement. "Autopilot overdid it!"

Joe struggled to drink the pink, bitter medicine. The other people watched him. In the corner of the room, incongruous by its presence, a green parrot shifted its feet on a makeshift perch. Sulky and ruffled, the parrot watched Joe too, with one beady eye.

"He'll be all right," declared a voice. Joe vaguely recognized the authoritative ring: it was the colonial governor speaking. "So will we. This ship is more than fully equipped to terraform a desolate planet, to make it habitable. By the same token, we can, if necessary, unmake one. Sterilize it, if the native forms of life are inimical to us."

"Surely that will not be necessary!" exclaimed Wing. "What of our other options here?"

"Options?" Joe asked.

"Watch the window," said Catharin. To Joe's vast astonishment, another planet rolled into sight. This globe had no land masses at all, just the water of a sea as wide as the world, under swirling clouds. "It's a moon—or rather, the planets are moons for each other," she said. "Somebody turn off the lights—?"

The artificial lighting flicked out. In its place, an eerie blue radiance flooded the room. "Sea-moonlight," said Catharin.

"Pretty," the Governor said drily. "But those clouds are hurricanes, worse than any of Earth's. It's an uninhabitable world."

"But there is yet a third planet in this solar system's habitable zone," said Wing. "There, the red-brown star . . . this system's Mars, more or less."

"More sizable than Mars back home," Commander Atlanta said without enthusiasm. "Less circular orbit."

"But what do we know about the green one?" Joe asked.

The ship had been here for three months, studying the world, sending down probes, finding a breathable, oxygen-nitrogen atmosphere. There was an isolated, equatorial mountain down on the planet, the peak of which had been flattened and sterilized with a single clean fusion bomb. The first landing by a manned shuttle had been made there. A base camp would soon be set up. . . .

Joe stopped listening. He was distracted by his physical sensations. The medicine was burning out the cotton in his insides.

No one had bothered to turn the lights back on. In the huge window, the stars wheeled by. Never in his life had Joe seen stars like that: shining shoals of them, laced with dark rifts and ropes. Joe abruptly asked, "Catharin, what did

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you mean 'on and on'?"

Silence fell. Catharin looked away.

"What year is it?"

Atlanta said slowly, "It's the year thirty-two ten."

Joe Toronto nearly fainted. From before the beginning of the starflight, he remembered the projected time limit for stasis, how fantasically overlong it had sounded, how absurdly millennial: one thousand years. But the flight had taken one hundred and seventeen years more than a millennium. They had gone a solid 10 percent over the purported safe limit.

By now, the cells in his body had sustained irreversible damage. The molecules were hurt. With physiological consequences that might prove to be unpleasant. And possibly fatal.

Joe felt sick.

The ship shrank as Joe watched through a porthole. As the shuttleplane pulled away, more and more of her came into view, a huge sphere with relatively few lights near her north pole. Those few lights represented the habitat of more than one thousand awakened people. Mostly dark and dormant, the ship was an enormous Earth egg, Joe thought.

Three months of labor lay between his wake-up day and the present moment. Never in his life on Earth had he worked so hard. And never had he struggled against a chronically unhealthy body. But the damned stasis fever refused to go away. His months' work now seemed as desperate and brief as a night full of bad dreams. He was going down at last: one brief descent and he would arrive at Unity Base—and at the cusp of the future.

Settling back into his seat with a sigh, he glanced at his one fellow passenger.

"Dr. Toronto!" said Wing. "Your health has finally returned?"

"No," Joe grunted. "But I need to be at the base."

Wing continued, "How unfortunate! But I suppose that your research can't wait any longer, stasis fever or none."

Joe grimly smiled out of the cabin window.

From the cockpit, the shuttleplane's pilot chimed in, "We've all got a touch of stasis fever!"

"Including you?" Joe asked.

"Yeah, but it's clearing up. Don't worry."

The plane angled down from the ship's orbit and streaked across the planet's nightside. With a blue splash of radiance, the hurricane moon rolled up from the horizon. Ironic, Joe thought, cosmically ironic that the diligent autopilot had brought the Ship to a solar system where the habitable zone held not one but three planets.

Joe turned toward Wing. "Haven't I heard your name in connection with the Third Planet Option?"

"Possibly so," Wing said modestly. "I am no xenobiologist, only a botanist who has specialized in the study of ferns. But I think that this world is unsafe for us to colonize—even if we burn bare places in which to settle."

Holocaustic site preparation. Joe did not intend for that particular future to come to pass.

Wing continued. "The Third Planet, though, is barren and lifeless already. When we left the Solar System, Mars was being terraformed with success;

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this one would turn out more nicely."

"That's not saying a whole lot!" interjected the pilot. "Secure your belts, gentlemen."

The bulk of the planet swelled. Joe suddenly noticed how the nightside looked. The big seamoon's light stained the dark world, splashed vast splotches and streaks of cobalt across the topography.

With an initial tremor that offended his stomach, the shuttleplane penetrated thicker atmosphere. Soon the plane shook. G-forces punched at his guts. Cursing the fever, he hoped that the anti-nausea drugs would do their job. A fiery friction mist swirled beyond his window.

Finally the ride smoothed, to Joe's relief. The window filled with the red light of a sun on the horizon. Beyond that cataract of light, he could barely discern daylit landscape hurtling by below. Eyes watering, he looked away. On the other side of the cabin, Wing sat glued to his window like a schoolboy on a field trip.

"Setting sun ahead!" the pilot sang out. "We're flying from east to west. Present altitude two miles. Welcome to Westpark!"

"What?"

"A nickname for this world," Wing supplied. "West—because that word has romantic, adventurous connotations. For Westerners." Wing sounded sour. "Some of the expedition members say that this world reminds them of a park."

"Huh? Why?" said Joe, genuinely surprised.

"Because it seems to be all trees and lakes, mild weather, gentle topography, and no animals." Wing leaned closer to make himself audible over the air noise.

Joe had seen the reports that came up from Unity Base, but he had not paid attention to the emotional footnotes, the human reactions on the part of the expedition team members. But now it would be useful to know how they felt about the planet. "No sign of animals—how do people feel about that?" Joe asked innocently.

"Mmmm. Disappointed, on the whole! Hopes are high for discovering large creatures in the seas."

It wasn't technically true that Westpark seemed to have no animals. The world harbored plenty of animal biomass. Consisting, in the words of the microbiologist Srivastava, of "slugs, bugs, and crud." Invertebrates, insects, but above all else, microbes. "Such lovely crud!" Srivastava had exclaimed. By that, he meant that the microbial ecology was at least as elaborate and extensive as Earth's, and exotic in many respects. Srivastava was the happiest scientist on the ship.

"Thus this world is not a park at all," Wing was saying. "There are no birds, no squirrels, no butterflies, and none of the flora which evolve together with the higher and more active animal life. Westpark has no flowers."

"S'OK," said the pilot. "We brought our own! Be ready for a big turn coming up, fellows."

"What about those slugs?" Toronto asked Wing.

Wing shrugged. "Large enough to have acquired a nickname. They are called zucchini slugs."

"But not anybody's idea of interesting animal life, eh?"

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Adjusting its bite on the air around it, the shuttleplane turned back toward nightfall and moonlight. The red light in Joe's porthole faded. His stomach disintegrated.

The pilot spoke on the radio, apparently addressing Unity Base. "Coming in on scenic route one. Over." To his passengers he said, "The Third Planet doesn't look very inviting compared to what's down there."

"We are not invited," Wing said sharply.

Joe had already seen the land around Unity Base, on televison, and had listened to explanations of its every feature, to the point of surfeit. He half-watched the expanding landscape as the plane descended. Shallow lakes were strewn across a plain. Anaerobic bacteria tinted the lakes red and purple and chartreuse, like puddles of tempera paint. Westpark indeed, he thought, an asinine nickname—yet one which might mitigate against holocaust.

East of the anaerobic lakes, the land got higher and drier, a rumpled rug, its dark green nap worn and bare in places. Rain showers dotted the slight hills in the distance ahead. Taller than the other hills, Unity Mountain lifted its head above the showery clouds. It was not much of a mountain by Earth standards.

"Look at the mountaintop," Wing said gloomily. "Even from here, you can see the absence of vegetation where we blasted the peak flat. This world suffers its first wound from the devices of mankind."

Flying too high and fast for a landing, the plane banked instead. Joe guessed that their path would consist of circling the mountain a time or two, low enough to get an eyeful of scenery. Wing reattached himself to his window to take in the view.

Joe gritted his teeth and told his stomach to lie still. At this point, that organ was affected by more than fever: he had begun to anticipate meeting the expedition team at Unity Base. Few in number, they included a good third of the colony's leaders—the most healthy and vigorous third, at that. In the next hour or so, with his words and his science, he intended to chart the future of the colony.

Disengaging his briefcase from the safety rack, he clutched it, pressed it against his knotting and squirming stomach. He had spent three months, and possibly what had been left of his health after the starflight, to reach this hour.

Wing's voice interrupted his thoughts. "Look at the roots of the mountain! I have not seen that before—the vegetation looks maroon, like wine. That is the zone of dusk, I think. The red light of sunset and the blue light of the moon, making a wine-dark bath around the feet of the mountain," he rhapsodized.

"But the mountaintop—it is still sunlit. There is iron oxide in that bare soil. And now it looks so red and raw," Wing said softly.

Joe grunted.

"Hey, we can make some grass grow over that!" the pilot said defensively. The plane swooped below the level of the mountain and banked. "We haven't exactly had time for landscaping!"

"Shut up and fly!" Joe told him.

Wing said half to himself, "Even these park lovers only understand nature

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when it is remade by the human hand. Broken and butchered first, and then lovingly remade."

"This world, as is, appeals to you?" Joe asked.

"Yes. . . . I do not see it as a park made for us to find. Its ecosystem is alien yet beautiful. Life is abundant here, and without animal violence, so far," He smiled slightly. "Perhaps, if we leave this young world to itself, intelligence will arise by less bloody paths than on our world."

"You're wrong," said Joe. "This world isn't young. It's old."

Wing's eyebrows shot up. "Oh?"

"Life has existed here for eight billion years. Without producing intelligence—without even producing animals. This ecosystem has totally failed to develop higher forms of life."

"How do you know that?"

With the toe of one long leg, Joe nudged the cockpit door. It clicked shut. The pilot did not need to hear this. "They've generated a hell of a lot of data down there at the base. And it's all been telemetered to my lab on the ship. So—my research has been going at full tilt for three months now."

"And why has this been kept secret?" Wing demanded.

"Politics." Joe grinned thinly. "This morning, on behalf of my committee, I made a formal recommendation to the colonial government. I'm going down to Unity Base to deliver my recommendation in person. And to explain the findings that support that recommendation." He tapped his briefcase. "I think most of the expedition team will be happy to hear what I have to say."

"May I ask what is your recommendation?" Wing said tensely.

Joe answered, "To colonize this world, without extraordinary precautions."

"No!" Plainly, Wing was appalled. "But you are a biologist! A molecular biologist, who should know about invisible biological danger! How can you advocate such a careless approach to an alien world?!"

"Yes, there are microbes here," Joe countered. "But they are characterized by two things: specific adaptation to plants, and slow activity including rate of mutation. We, on the other hand, intruders that we are, have our own, exquisitely mutable terrestrial microbes. And razor-sharp immune systems—compared to those of the native organisms." Joe gestured breezily. "On the molecular level, things happen slowly here compared with Earth."

"You are certain?"

"Believe me, the data are convincing. Then there's the fact that we brought science with us—in particular, a highly advanced level of molecular biology and genetic engineering. State-of-the-art labs, top-notch doctors and scientists. So, I guarantee you, we can outrun *and* outfight the native microorganisms!"

He decided to let that sink in for a while. Glancing out of the window, he saw clouds and one thunderhead in the sky around them. The thunderhead, not very much like the ominous anvils of Earth, looked pink and pudgy.

"How can you reach such conclusions when you have not even been down there?" Wing demanded. "You have no first-hand knowledge of the planet!"

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"Not necessary. I work with a computer—massage the data and make models to account for it. I'm a scientist, not a naturalist!"

"Is it not enough for your science to conquer a lifeless world?" said Wing, flushed with anger. "Is it so much better to conquer a living one?"

"You'd rather see it burned? Believe me, your Third Planet movement doesn't stand a chance. But a lot of people—such as our pilot friend there—are going to welcome my recommendation. If you pull with me, we may—barely—swing the balance away from local holocaust!"

Evidently Wing would not be turned into an ally so easily. "A plague on both your houses," Wing said bitterly.

The plane curved around the side of the mountain. In the dusky sky, the seamoon rolled by, shining blue and bright as a beacon.

On the mountain below, in the maroon dusk zone, Joe thought that he saw a river: a trace of water running down the densely vegetated slopes.

And then for an instant it looked like blood, a blood-red trickle from the blasted mountaintop. The brief vision jolted him.

The light did it. Light from a sun redder than Sol, setting, mixed with the big blue moon's light. Such a dusk the human eye had never known before. The eye did not know how to interpret it. That, plus the stasis fever and the guilt that Wing was trying to disseminate, had made him see blood on the mountain. Clammy sweat beaded on his forehead.

"I do not dispute your science," said Wing. "Perhaps we have the knowledge and the might to make ourselves at home here. But we do not have the right!"

"We reached the stars," Joe said shortly. "That gives us the right."

The plane started to climb. The last of the energy of dropping out of space had been burned off; they felt the engines kick in powerfully. Presumably they were climbing toward Unity Base to land, the scenic tour mercifully over.

"Can you open the cockpit door?" said Wing urgently. "Tell this character to stop showing off. We are flying too close to the mountainside for safety!"

Joe started to reach for the door, but as he did he glanced out through the porthole. He froze. The storm loomed over the plane now, a mass of cloud standing on a thick leg of precipitation. Lightening flickered in its belly.

They hit the fringes of the thunderhead's rains and winds. The plane quivered. Joe sank back and pressed the briefcase against his quaking stomach.

With a sick fascination he watched the storm. The cloud and its rain still did not look as violent as the storms of Earth. But they looked wrong, the thunderhead misshapen, too smooth and not puffy enough, the rain that issued from it flushed with a maroon color. He stared fixedly and tried to convince himself of the simple meterological nature of the phenomenon.

Instead, in the alien light, Joe suddenly saw the clouds as a bleeding mass: vast flesh mangled beyond recognition. Vast wounds spurted blood. Rains turned into streams of blood. The gory rain spattered the plane's windows. Joe flinched.

Incredibly, so did the plane.

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The plane veered sharply away from the rain. The mountain leaned over them. Wing cried, "No!" Now the plane veered the other way. But a downdraft lowered on the plane like an invisible fist. The plane dropped abruptly.

The plane twitched as the pilot fought to regain altitude and control. It was too late. The plane's wing grazed a treetop with a grinding scratch. The plane twisted, throwing Joe against the straps of his seat belt. Clear water streamed on the porthole glass. And then a hell of noise and violent motion broke loose. Cracking pain seized his left shoulder. In agony, he struggled, caught in a contorted position. He blacked out.

Joe phased back into consciousness aware, only aware, of horrible pain in his shoulder. Joe cursed the pain until it backed off.

Curled up on sloping ground, he felt the roughness of dirt and duff under him. He began to notice a kind of vague light, a twilight, around him. Propping up on his right elbow, he saw one, two, three dark blue tree trunks not far away, and then, downhill, a steaming metallic ruin. He stared incredulously.

Wing emerged from the the ruined plane and hurried uphill. "How do you feel?" Wing crouched beside him.

"Godawful," he mumbled. "Something's fractured. Can't use my left arm. Head hurts, too." With his right hand, he explored his scalp. A cut: his fingers came away bloody at the tips. "What happened?"

"I do not know why we crashed," Wing said shakily. "The plane ended on its left side. Where you were. I managed to pull you out."

"The pilot?"

"The nose of the plane hit the mountain first. He died." Wing bowed his head.

Rain began falling. It came down almost soundlessly, dripped off Joe's hair. Meanwhile, the pain in his shoulder eased to a tolerable level. Joe felt his left hand stinging. To examine it, he had to use his other hand; the left would not turn on its own. He discovered a nasty scratch. Both hands were streaked with soft black organic soil. He shuddered.

Wing said faintly, "I got him out of the plane just in time to give last rites."

"What?!"

"Last rites." Head still bowed down, Wing sighed. "I am a priest, of the kind who has a secular profession too."

"Well, if it comes to it, don't try that with me!"

Wing looked up incredulously. "You are not a believer?"

"I'm an atheist!"

"Perhaps you should reconsider that," Wing said sharply.

"Like hell!"

"Where is your science now?" Wing demanded. "Your computer is on the ship. We are here in the forest dirt. Eternity—"

"Reality hasn't changed. And I'm not about to trade it for superstition!"

"Eternity is nearer to hand than science now!"

"Prove it," said Joe.

"I cannot, but—"

They heard an engine whirring. Both looked upward instantly. "That is the survey copter," Wing said. "Searching for us." The whir swelled, faded. "They will not see a trace of us," Wing

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whispered. "Look at the forest roof."

Slender tree trunks rose into the air all around them. High overhead, the trunks branched into fronds, massive crowns of fronds intermeshing with each other. And Wing had it right: there was no break in that canopy, no sign that the plane had crashed through it.

"Radio?"

"The crash destroyed it."

"Crash beacon?"

After a moment's hesitation, Wing answered, "I do not know." The whir faded away into the faint slither of the rain. "They will come back," said Wing. But he sounded far from confident, and he absently wrung his hands. "If nothing else, our colony cannot afford to lose you!"

"Just so they don't waste time about it!"

Wing shook his head glumly. "There are no plans for accidents like this. It may take them much time to decide how to search for us without exposing the search party to biohazard."

"If the biohazard is all that serious, they might as well not bother," Joe gritted.

The raining wind sighed and breathed through the forest canopy.

Finally Wing said, "If you are not going to die, then I must climb to the base to get help."

"How far?"

"A few miles, perhaps."

Joe stood up and twitched his shoulder. Now it didn't hurt, didn't feel at all. "Painkiller?"

"A potent one, yes. There was a first aid kit. I also salvaged your briefcase," he added.

"Intending to throw it into the nearest lake?"

"I respect reality as much as you do," Wing said stiffly, and handed the case over. "We differ in our interpretation of it."

The rain ceased. Cobalt silence surrounded them. Wing looked uphill, then down toward the wreck. "I pulled a large broken frond over him. That's not enough, but—"

"It'll do. See if there's a sling in that kit!"

Wing obliged. With his useless arm secured, Joe felt at least marginally fit for a desperate hike.

The seamoon must have been high in the night sky above the forest. A viscous blue twilight filled the air under the trees. It made for uncertain visibility. Joe could discern the nearest few tree trunks. Everything beyond that melted into a murky sketch done in blue ink, suggestions of trees or foliage. His first few footfalls made sharp thin pains radiate through his body.

The first part of the climb seemed simple, a steady slope without much undergrowth. But slippery moss coated the ground. Both men lost their footing and pitched forward repeatedly. With his good hand, Joe had a grip on the handle of the briefcase. But when he slipped, the thing kept him from simply catching himself. He felt like an utter fool, floundering his way up an alien mountain with a briefcase. So he paused to open it. He removed the briefcase's slim computer and tucked it into the pocket of his jacket. The briefcase itself he threw away.

Something glowed in the blue gloom. Wing hesitated, then went closer to investigate. It was a dead tree. Some kind

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of fungus coated the tree in thick, dripping sheets like candlewax, emitting a faint yellow-green glow.

"Don't touch that!" Joe said harshly. "No microbes here are specifically hostile to us—but chances are some of 'em produce toxins. Metabolic byproducts that just happen to be toxic to human beings!"

Wing stopped short. "It could be perilous to touch anything at all, then!"

"So could standing here breathing the air. Let's go."

The painkiller seemed to have made him light-headed. Between one footfall and the next, Joe was seized by the feeling that this place might just as well have been the bottom of the sea: liquidly shadowy, ultramarine and silent. Following Wing, he moved in slow motion, like an ancient diver, his feet leaden, his head weightless.

With a startled cry, Wing pitched backward and started sliding away. Joe reacted barely in time to save him. Throwing himself to the ground, he grabbed Wing's wrist with his good right hand. Which saved Wing from disappearing into a long deep darkness. The slope underfoot had quite smoothly taken a steep turn downward.

"God-almighty-damn!" Joe swore. "That's a ravine!" With an effort, he hauled the smaller man back over the edge.

"Thank you," Wing said faintly.

Drug or no drug, the action had caused the pain in Joe's shoulder to flare up. He tried to rock the angry pain away.

Wing crept back to the edge of the ravine and peered into it. "I hear water rushing over rocks!"

"You could have been killed."

"Yes, I was careless!" Wing fumed. "Just like the unfortunate pilot, I assume too easily that this is not a dangerous place!"

The unfortunate pilot. The man had been too talkative, maybe careless, but not a bad guy, and he had died. The realization was sinking in. Joe was walking away from a bad crash. He could have been dead too. Or dying. Rocking against the pain, he shivered.

After brooding at the ravine a while longer, Wing said, "I do not think that is what you meant by proceeding without extraordinary precaution."

"No," Joe said. "Now what?"

"This ravine angles uphill. We should follow it that way."

"Just watch your step."

"I will watch with my toes. The eyes are not at home here!"

Wing edged along from tree to tree. The trees grew more slender, their foliage less dense; more moonlight filtered into the forest, improving visibility. The feathery crowns of the trees were silhouetted against the dim sky. "You're a fern specialist, eh? No wonder they defrosted you," Joe remarked. "These things sure look like prehistoric fern trees."

"So the Vanguard thought."

The ravine rapidly grew shallower, evolving into a treeless depression that ran like a ribbon as far up and away as the eye could see. Illuminated by full seamoonlight, it glowed, blue-green. "Damn moon puts out a lot of light," said Joe.

Wing halted at a narrow spot in the long depression.

"Looks boggy," Joe said dubiously.

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"And either I'm feeling my fever, or it's hot here."

"It is hot and humid. And the air smells strangely, does it not?"

"Loaded with volatile organic molecules. Well, you're the field man. What do we do?"

"Cross here. I go first; you follow in my steps. Be ready to give me a hand if need be!" Wing took cautious steps, found firm footing as he stepped in vegetation that came up to his shins. He paused. "These plants are odd! They shake even though there is no wind here." He bent over for a better look. "What do you say is the color?"

"Well— Green. But not green." Intrigued in spite of himself, Joe continued, "Doesn't look like any color at all, but it's green!"

"Yes. I do not see any color either, yet the plants appear convincingly green. What strange light." He touched a leaf. It resembled a fern, curled at the top, the rest of the leaf wide with frilly edges that quivered. "Look, the leaves have their heads curled up as though they are asleep like birds. And they shiver in their sleep!"

"This isn't a field trip," Joe reminded him. "And get your head up away from the muck!" Joe was acutely aware of the strange organic smell. It nagged his nostrils.

Wing straightened. "Colorless green ideas sleep furiously!"

"What?"

"That is the textbook example of a perfectly grammatical but meaningless sentence in English." Wing informed him. "I never expected to see any."

"Why don't you keep your mind on getting across?"

Joe put his feet where Wing had stepped among the colorless greens. He heard faint crunchings underfoot, from the underlying mat of vegetation saturated with water. Grimly he calculated that he outweighed Wing by fifty pounds at least.

"This is the center—it is solid —enough," said Wing.

But it proved solid enough only for Wing. Joe's foot tore through the mat into mud beneath it. He lunged ahead. His other foot sank into the mat. The mud reeked of overripe bananas. An instant later, it smelled like a latrine.

"Can you pull out your feet?" Wing asked urgently.

"*Ugh!* Yeah—" Joe plowed through the mud. The smell wrapped itself around him, oscillating between fruit and sewage. Nauseous, Joe stumbled onto drier firm ground. He tasted the urge to vomit.

"That smell is strange," said Wing, leaning on a tree. "Yet almost familiar . . . " Wing lapsed into Chinese and then he started to cry. Dumbfounded, Joe stared as Wing slid down the tree and sat down in a huddle, sobbing into his knees. "That smell!" Wing's words were muffled. "It is—" He choked and sobbed.

Seizing Wing's collar, Joe dragged him uphill into fresher air. Joe breathed deeply and fought off his own nausea.

"That smell!" Wing said finally. "Ah!— it reminded me of my mother's kitchen!"

"What?!"

"The fragrance of peanut oil heating in the wok. Delicious reused peanut oil," Wing said sorrowfully.

"Didn't strike me that way," said

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Joe.

"So real!" Wing murmured. "Many memories of home. Give me a few moments. I still feel overwhelmed. My mother died some years before the ship left. . . . " Wing trailed off.

With a grunt, Joe sat down to wait while Wing pulled himself together.

In getting himself out of the bog, he had ripped a trail through the plants. Never before on this world had that happened: plant life damaged by a large blundering animal. Now the semi-floating vegetation seemed to be drifting back together, his trail closing up, jagged as a stitched wound.

Joe shifted his gaze to the sky. A dim yet intense blue, more than anything else it resembled a color of computer cyberspace. Which reminded Joe that he had not done any real work since he came out of the ship's freezer. Assessment of other people's reports; politics; bossing technicians in the lab, yes. But not theoretical molecular biology. His genius was to lift up a great looming strand of DNA in cyberspace, and rearrange the bases, using the virtual manipulator that made it feel like physically handling the vast molecule. Until it felt right for what he wanted it to do that nature never intended. Then, he would tell the computer to give the novel DNA a workout, express the new gene through messenger RNA, proteins, and organs into the final organism.

He remembered the dog DNA. He had made manifold modifications to the canine double helix in cyberspace. His design had been reproduced by genetic engineers in real dogs in the real world. The result was a dog with gills, flippers and numerous other physiological modifications so that it could breathe and survive in salt water. By the time Joe left Earth, sea dogs were being used as helpers, messengers, sometimes bomb-carriers for undersea operations. Porpoises, useful in some of the same ways, were protected against being so used; they had para-human rights. The sea dogs retained the loyal and tractable temperament of Labrador retrievers.

He had really wanted to design and develop a winged horse, for the hell of it. But chimeras were expensive. They had to be practical and profitable.

The dark electric blue of the sky gave him ideas. Westpark needed animals. They could be made. The ship had brought a trove of germ cells from Earth—samples of every species that the ship's agents managed to buy or barter for in every ecological corner of the Earth. Here, there was a planetary pool of alien genetic material to investigate, and exploit, maybe recombine with genes from Earth. Why not? He fumbled in his pocket, took out the computer, and made notes, squinting at the tiny bright characters on the display.

With a world full of plants, there was plenty of food if engineered organisms could metabolize it. First, herbivores. Antelopes with appropriate digestive enzymes. Then, maybe, predators to eat the antelopes—but find people and other terrestrial organisms distinctly unpalatable. Though in the long run it might do the human genome good to have man-eating predators on Westpark: keep the genes for survival honed sharp.

Changeling antelopes and lions. But why not unicorns and griffins? Staring

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into the moon-lit sky, he imagined the coils of DNA, changes in the genetic code, transfiguration into breathing ornamented shapes, teratisms that would have been illegal, impractical, or both on Earth. His creativity had always been trammeled. Not so here. The possibilities were endless and compelling. One-handed, he frantically entered his ideas into the little computer.

Wing scrambled to his feet. "It is not a good thing to sit and think in this twilight!" he announced, and with that, dashed uphill.

Joe went after him. Tucking the computer back into his pocket, Joe broke into a cold sweat. Wing was right. Sit around in the twilight thinking, and colorless green ideas wake up furiously in your head. He did not know—would not know, until he got an uplink to the ship's supercomputer with its molecular biological data base—whether what he had just dreamed up made any scientific sense, or was lunatic fantasy.

Now they could go directly uphill again, on terrain with a steep but not unmanageable slope. Joe caught up with Wing. His shoulder felt leadenly numb. Elsewhere on his anatomy, nerve endings complained loudly, claiming to be scraped or scratched. Some of the abrasions might have been imaginary. He did not dare to investigate with his good hand. By now, that damply dirty hand must have collected a staggering number of micro-organisms.

Wing pointed to a short tree draped with filmy stuff that shone slightly. "Shroud worms," Wing announced.

Bugs, slugs, crud. Srivastava, with his smile full of white teeth, had said cheerily, "The cake is much like Earth, you see, the layers of prokaryotes and eukaryotes, single-celled and multi-celled microbes, then plants and arthropods and invertebrates. Only there is no decoration on the icing of the cake—no vertebrates. The carbon cycle works quite well without them. The atmosphere down there is much like that of Earth. Richer in oxygen, but only somewhat." But on Earth, Joe thought, the primordial crud had had more imagination.

Looking back at the shroud, Wing said, "That is considered an analogue to Earth's ginkgo. The ginkgos flourished with the great dinosaurs in Earth's Jurassic period. Yet here, nothing more complex than shroud worms eats that tree. The plant life and animal life are very far out of phase! Has your committee found an explanation for this?"

"Maybe. The native organisms have a kind of ribonucleic acid for genetic material. Slightly different from terrestrial RNA and DNA, and, it turns out, more stable. Too stable. My guess is that you need a certain mutation rate to make enough random experiments so that some of them go to the kind of nervous system complexity that makes for higher animals."

The pseudo-ginkgo trees were small, branchy, rooty and close together. Joe fought his way through, while Wing slipped between the tangled trees like a cat. He paused to wait for Joe. "Could it not be that the pace on this world is simply slow and that animals will come about in time, if we let the world be?"

"I doubt it, because the genetic material is incredibly junked up in almost every organism we've studied. Ratio of genes that mean something to genes that

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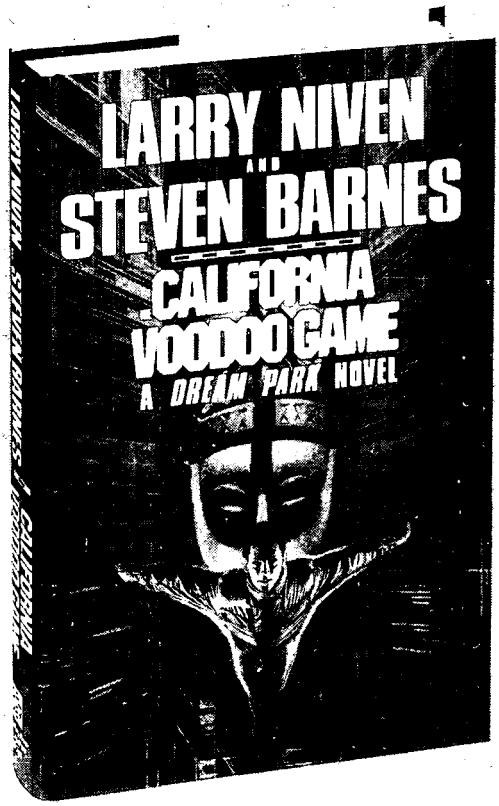

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mean nothing is absurdly low, more so than Earth's record-holder in that respect—the lungfish, which has fifty times more DNA than a human being, and that's a hell of a lot more DNA than you really need to specify a lungfish. But one of the slug tissue samples collected by Unity Base had six hundred times more genes than the nearest Earth analogue."

"I do not see how unexpressed genes must negate the further evolution of slugs," said Wing. "Of course, I am a botanist rather than a xenobiologist."

Joe detected a nettle. Joe was no xenobiologist either. His qualifications to direct the advisory committee had been questioned by some of the scientists who were. To no avail: the reins had stayed in his hands. "Evolution here was never able to jack up to higher lifeforms. And now it's too late," Joe said flatly.

Wing forged ahead in silence.

The bright blue gloom made it all but impossible to judge the position of obstacles. "Still think it's beautiful?" Joe said sharply, after tripping over yet another root.

"Yes, I do," answered Wing, "philosophically. How I feel is another matter."

"You don't feel sick, do you?"

"No. But . . . I am unnerved. Things here have no names. Somehow I would feel better if I expected a dinosaur—a ferocious allosaur—to crash through the bushes." He ducked into a thick band of trees. Long, pliable branches hung in the way with masses of round leaves.

Wing seemed healthy enough. But Joe wondered morosely about his own weakened, fevered body. The ragged molecules and wounded cells of stasis fever—how vulnerable did that make him? "Ever read about the Black Death in medieval Europe? People literally dropped dead. I keep thinking about that," said Joe. "Irrationally expecting wild viruses to rustle in the air. And water. And goddamned dirt."

"That is more likely than allosaurs," Wing said in a low voice. He eased past a thick skein of branches. Joe followed more clumsily.

"More likely than allosaurs but still damn improbable," said Joe. "I'm no fool. I recommended colonizing without extraordinary precaution because the findings are straightforward." He patted the computer under his shirt, almost as if to reassure himself of its tangibility. "The idea of an alien virus scares the hell out of people who don't know better. But viruses are parasites fine-tuned to their hosts. No mammals here means no virus even remotely prepared to exploit the mammalian organism. No alien virus is going to ambush us."

"Most regrettable!" said Wing, heading up a steep incline laced with roots and branches.

"You'd rather drop dead?!"

"No. But if the prospect of such a danger convinced the Vanguard not to colonize this world, then I would not be unhappy!" Wing emphatically pushed a fat leafy branch out of the way to climb past it. Joe failed to catch the branch before Wing released it. The branch struck Joe in the face.

"Keep your martyr complex to yourself!" he snarled.

"So sorry!" Wing said.

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"How far do we still have to go?"

"Less than half of the way, I think. We have come far. This world's gravity is a bit less than that of Earth, and walking uphill is easier."

Joe squinted into the ultramarine gloom filled with shapes and shades that had no names in human language, yet. The unearthly silence—no birds, no insects, no wind—pressed down like the stillness of the deep sea. Joe felt lightheaded, as if his head weighed nothing. Sweat coated his bare skin. Its chill made him think of being in seawater. Maybe instead of an allosaur jumping on them it would be a shark lowering from above. And maybe he was slightly delirious from the stasis fever.

Wing examined a branch. In the uncertain light, he puzzled over it. "Tetrapterous!" he declared.

Joe asked, "How the hell can you be a field botanist and not want to live here?"

"Oh, I do!" Wing said quickly. "But if we colonize this world, we will eventually wreck it. It is bad enough that we wrecked the world of our origin."

"Our ancestors did," said Joe. He added pointedly, "Particularly those nationalities who grossly overpopulated their land."

"Come," Wing said shortly. "Night is falling."

The leafy trees thinned out slightly. But the gloom turned darker and less useful for seeing. The ground roughened. Joe stumbled on big rocks, making clumsy missteps that caused the sling to chafe the back of his neck. In what was left of the light, the way up the mountain looked steep and forbidding. Jagged stone outcrops slivered the starry sky.

"This mountain is openly rocky only at its crown." Wing sounded hopeful. "Our maps in Unity Base show many streambeds running down the mountain's crown. They seem to be the courses where rain or melting snow runs off in some seasons. At this time of year, the streambeds are dry and full of low, annual vegetation, and may be the easiest way up."

"What if the vegetation has thorns?"

"In the absence of animals here, that is unlikely."

Because Wing hoped to strike a streambed, he angled up the mountainside. That was fine with Joe. The going was difficult enough without trying to go straight up. After the jolts of slipping and stumbling repeatedly, Joe's shoulder began to ache again. And his good right hand got still more scrapes. Blood, plant juice, dirt, water, and sweat mingled madly on his skin. He gritted his teeth and followed Wing.

To make matters worse, the sea-delusion came back. This time he found himself obsessed with the idea of climbing up from the still blue deep into a killing surf. It became an act of will to put one foot in front of another. Even while cursing his brain for its gullability, he experienced the irrational sensation of wave action rocking his body. He was racked by the feeling that, if he climbed higher, the surf would fling him against murderous rocks. In desperation, he determined to master the delusion and all of its relatives: to figure out why they happened.

He went to work, attacked the facts with total intellectual concentration,

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made an all-or-nothing contest of it. And won—a more personal victory than usual: his mind made logical sense of the circumstances that had been toying with his brain. The sea-delusion faded away.

Joe grinned, an invisible expression. Night had fallen. In nearly total darkness, they had to inch along by feel.

The land dipped, turning loose and pebbly as it did. "This is our dry waterway, I hope," Wing panted. "Let us ascend."

"Fine with me!" Joe charged uphill. Stones slipped and turned underfoot. Then his heel struck something soft and slippery, causing him to come crashing down on one knee. Wing was by his side instantly, helping him up. His knee hurt. Joe cursed furiously.

"You have just stepped on the highest life form of Westpark," said Wing. "It was a zucchini slug."

"Too bad!" Joe grated. He limped to a large rock and sat down on it. Nursing his skinned knee, Joe brooded. "Park, hell! This world's way too weird to call it a park!" Wing simply seated himself on a nearby rock. Joe said, "You know, you really cracked up back there. In the bog. Anything like that ever happen to you before?"

"Certainly not!" said Wing, a shadow with an indignant voice. "Smells often inspire nostalgia on my part, but not so overwhelmingly as that."

"Did you see anything outside before we crashed that could have startled the pilot?"

"No," said Wing. "Did you?"

Briefly Joe described the delusion of mangled and bleeding clouds. "A sight like that, plus his 'touch of fever,' might explain him making a bad mistake."

"He was flying too close to the mountain for safety. People in Unity Base have tended to become careless, as if this were a park and we all came here on vacation." Wing was silent for a moment. "What was it—the blood clouds?"

"Water, air, and light," said Joe. "And animal brains."

"We imagine violence when there is none?"

"No. Given hopelessly inconclusive data, our brains jump to conclusions." He shifted to a less uncomfortable place on the stone. "What happens when you look at a visual paradox—an illogical drawing? Your brain shuttles between alternative interpretations, rather than dismiss the thing as impossible."

"But such inventions are indeed impossible. Unnatural. This place is utterly natural."

"That," Joe stabbed at the talking shadow with his forefinger, "is a philosophical premise, not an experiential one! As you are wont to point out, my friend, we did not evolve here. For us this place is *not* natural!"

"Mmmm . . . "

"Now, if a smell drifts into your olfactory receptors, and it consists of complicated organic molecules unlike any on Earth—what does the brain make of it? Dismiss it as nonsense, or jump to a conclusion?"

"Possibly the latter," Wing admitted. "But if so, I must admit that my brain has jumped to astonishing conclusions this evening. At one point, I smelled wet dog. And again gasoline.

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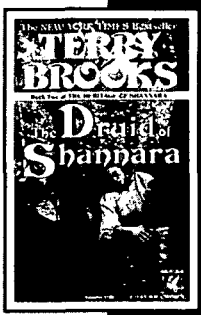

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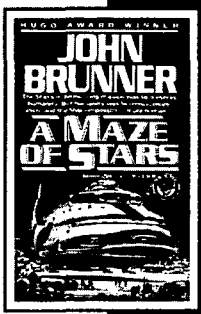

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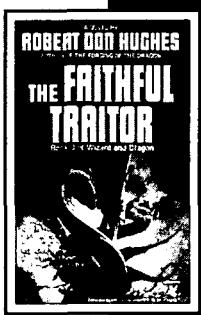

A SACRED STONE, A SENTIENT SPACESHIP, AND A SLY SORCERER—

FROM THE FIRST NAME IN IMAGINATION...

DEL REY

#1 in Science Fiction and Fantasy

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Then there was the hot peanut oil."

"Your wok bog produced a complicated smell, God only knows how many different organic volatiles, how many accidental similarities to terrestrial molecules that occur in totally different contexts. What we had there was the olfactory equivalent of 'Colorless green ideas sleep furiously'! Sure, your brain was astonished. Jumped to a conclusion at random."

The shadow bobbed, Wing nodding. "Perhaps so! But the blood clouds would seem to be a far simpler puzzle to the senses, and a less immediate one. How could that have so startled our pilot as to precipitate a crash?"

"Right then, he hadn't left himself much room for error," said Joe. "Now, *think about that light, Catharin's 'sea-moonlight.'* In the context of our evolutionary history that's unnatural. Bright blue moonlight—mixed with red sunlight—alien! And the clouds here look different—the gravity's different—hell, the bottom line is an alien gestalt. *Everything* is slightly different. Adds up to a global intuition of impossibility, eh?"

"Mmm! Mmm! But does that necessarily cause people to succumb to . . . ?"

"Let's say delusions. Compelling ones. People go about their business, the sense of impossibility reaches critical mass and then brains jump to conclusions. Illogical ones, maybe disastrous ones."

The shadow moved. Wing was going to look at the crushed slug. A breeze lightly stirred the surrounding trees. And it was not more pleasant than the dead stillness which had preceded it: the breeze made a whispering sound in the trees. If he dwelled on the wind whispers, Joe's brain would jump to the conclusion that it heard sibilant words.

"I thought I saw the remains of the slug move and wondered if it were another illusion," said Wing. "It was not. The undertakers have arrived."

"Undertakers?"

"Insects—or insect analogues of some kind—the ground is alive with them. They are stirring and digging, and the slug is disappearing into the ground." Wing's voice sounded slightly strangled.

"Let's get out of here," said Joe. Neither of them mentioned the dead pilot, lying under a broken frond on deeper and darker soil than the dirt here. *Together they fled uphill.*

The ground underfoot was a mess of loose rocks and scree. The scree slid out from under Joe. He seized a bush. It doubled over like rubber, letting him fall flat and hard, which knocked the wind out of him. When he finished wheezing, Wing said, "Go by hand and foot. That way there is less far to fall."

The terrain got even worse. It turned into a jumble of rocks and plants. The stuff tended to slip, taking them down with it in a shower of dirt and leaves. Joe's shoulder hurt savagely. His thin, strained grunts sounded almost like whimpering.

Wing paused. "Is the painkiller wearing off?" he asked, lightly touching Joe's shoulder. "I have the kit. There is another ampule, if I can see to administer it in the dark."

"After we're out of this!"

They crawled further. "This is debris!" Wing exclaimed. "We are near

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the top of the mountain. Material from the blast fell here."

Minutes later, they emerged from the jumbled plants and ground. A sky full of stars hung above them and the mountain's bare crown loomed ahead. With a groan, Joe lay flat.

"Now for the medicine," Wing said, briskly unzipping the first aid kit. "Ah! I can see fairly well. There is so much starlight." He carefully injected the painkiller.

"Looks pretty clear from here on up."

"It is steep, with a few trees. Mmmm. There must be a chain of waterfalls in the season of melting snow: I see many steps or terraces. That will make it easier for us."

"Is that your Third Planet?" Joe pointed to an untwinkling, ruddy point above the mountain.

Wing sighed. "Yes."

"You've got a religious affinity for it." Joe said suddenly. "Never mind the scientific camouflage, why are you convinced that we ought to start the colony there? Why shouldn't we have a second chance to cooperate with nature—here?"

"Since you ask," Wing said slowly, "Because God has not given this world to us."

"How do you know?"

"God gave us the Earth and its living things to name, to enjoy, to use. I cannot believe that the same rights extend to the universe and everything in it!"

"Huh. So what are you doing here?"

"I am wondering about that myself!" Wing replied ruefully. "I do not feel that we must stay on Earth forever—as some believers insist. There is nothing wrong with the journey to the stars, to terraform a barren land—working with sweat and many sacrifices to build a good green home for our kind, and for the creatures which we brought with us in the ship. It is not," he added, "a luxurious prospect! Yet it is what all of us expected when we left Earth."

"So God gives us a better option," said Joe. "Has the right to do that, eh?"

"True," Wing admitted. "But I believe that what we are given is not a better option, but a hard choice. To choose hard labor or sloth, humility or arrogance, sacrifice or greed. A wilderness or a park." He propped his head on one hand, looking up at the ruddy spark in the night sky, and continued sadly. "Almost no one seems to think that the choice is hard at all! Everyone blithely assumes that this Westpark is a gift from God or from the Universe."

Mercifully, Joe's shoulder was going numb again. He gazed up at the night sky. Three planets, he thought. The third was potentially habitable, at least for future generations, provided that the present generation was willing to rough it. A second planet, the raw oceanic world: uninhabitable, so much so that no one, except the planetary scientists, had expressed any interest in going there. And then the first, this green world, immediately habitable, mild, tractable.

Wing was misguided, Joe reflected, but he definitely had a point. There would have been something ennobling about the challenge of molding a lonely globe in the wilderness of stars. Too bad that was going to be unnecessary! Joe suspected that human nature would not be improved by the cosmic equiva-

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lent of a free lunch.

Three planets, two, and one. Then and still there was the zero planet. The one that had failed to be there. The zero planet stretched from Earth to here, eleven centuries long and thin, a string of cold nothingness: attenuated death.

"Joe. Joe Norden—or Toronto. Wake up."

"Huh!?" He started, his heart pounding, surprised to be alive.

"Either the painkiller or my sermon put you to sleep. How do you feel?"

"Painkiller worked." He carefully climbed to his feet and took deep breaths. "I'll be damned, I can't feel the stasis fever any more! Maybe all this exercise burned it out!"

"I hope so," Wing answered.

The last climb turned out to be strenuous, but safe and fast. They ascended from one terrace of the waterway to the next. The pure white light of the stars made it easy to find hand- and foot-holds.

"Onward and upward!" said Joe, in a triumphant mood.

Trees of a new kind perched along the waterway: short, scrubby, and pungent. "Furry pines!" Wing said excitedly. "These are the dominant vegetation at the top of the mountain. I have studied samples of them. But I did not know that they smelled so—like celery?"

"I get seashells. You know, used ones. Or else antiseptic. Contradictory as hell, eh?"

The waterway petered out; the terrain flattened. They pushed their way into a stand of "furry pines." Some of the trees leaned outward at a 20-degree angle, with broken branches and roots half-pulled out of the ground. The damaged ones were resolutely thick with living needles.

"Tough little beggars!" Joe laughed.

Then they found burned and shattered pines. Hurriedly they scrambled through, and over, those. A heavy smell hung in the air: the stink of combustion, Joe guessed, though his brain came up with several odors, all wildly unrelated to burned cellulose.

Then they found the edge of the mountaintop crater. Shallow and wide, it curved away into the distance on both sides. In the crater's center, a quarter of a mile away, stood the geodesic dome of Unity Base. No fence surrounded the dome. No floodlights stood guard over it. None were needed on this world. The dome simply sat there, an angular bubble lit from within by yellow light.

Wing slowly seated himself on a fallen pine's trunk, near the edge of the crater. After a few moments, Joe sat down beside him. Exhilaration had vanished. Joe felt utterly drained.

"Haven't heard the copter since the first time," said Joe.

"I see it. It is parked on its pad, almost behind the dome from where we are."

A few minutes later, Joe blurted, "They're not dirty. They're clean in there."

"I know," Wing whispered.

"We ought to go knock on the door," said Joe, with no conviction at all.

"Yes," Wing agreed. Neither of them moved. An idiotic thought popped into Joe's head. If they knocked on the dome, maybe the bubble would burst and disintegrate. He picked up a handful of small rocks and pitched them, one by

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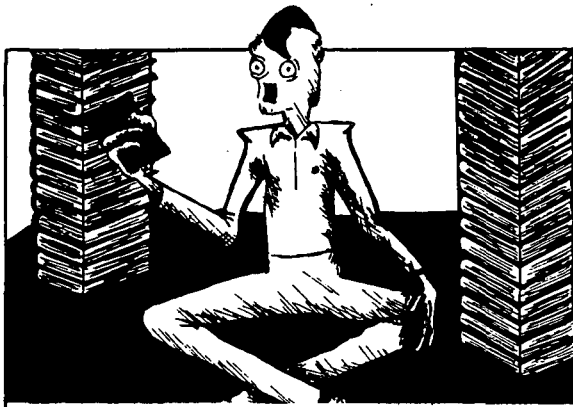

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one, back to the ground. Ejecta from the crater, these rocks had fresh sharp edges. Finally Joe said angrily, "Why aren't they looking? They ought to *hope* that we're still alive, and they know we're not necessarily sick!"

"They do?"

"Before I left the ship, I transmitted my recommendation to the Chief Expedition Scientist."

"Manhattan."

"Yeah. And an abstract of the findings that led to the recommendation, I transmitted that too. I'd have thought he'd send a search party out!"

"Perhaps he did not agree with your recommendation. Perhaps no one did and there were no volunteers!" Wing said unhappily.

Joe swore.

"Then again, such pessimism may be unfounded," said Wing. "Knowing these people, perhaps they decided to vote on whether to send a search party, what kind of search party, and with what degree of precaution. In which case they may democratically argue all night."

"*Wonderful!*" Joe exploded. "What time is it? I lost my watch."

"No, I removed it, fearing that your arm might swell." Wing handed over Joe's watch.

"Stopped! Reads two hours since we left the ship!" Joe hurled the watch into the ashes on the ground.

"Mmmm." Wing went over and ferreted among the ashes. Finding the watch, he examined it. "No, it is running! In truth, I do not think that we had far to come. And if our other senses are disoriented, why not the sense of time as well?"

"Maybe, but we can't wait all—"

A brighter pane of yellow light fell out of the dome: the door had opened. A small group of people emerged. Four of them, they hurried in the general direction of Joe and Wing. Joe saw that they wore landsuits, but no helmets. And they seemed to be loaded with gear, ropes, flashlights, pickaxes, bags.

Joe leaped to his feet and whistled. Wing shouted, "This way!"

The group hesitated and changed course, then came running toward Joe and Wing. The person in the lead looked familiar. Catharin. Instantly Joe was struck, as never before, by her beauty. Wing could talk all night about how Westpark was beautiful, but the planet was too weird. Beauty was this woman with the bright starlight around her, glazing her hair and clothes.

About two yards away, Catharin stopped so abruptly that the other three almost collided with her.

In an awkward silence, Joe put his free hand into his pocket. Then he cleared his throat and said, "Congratulations, we found you."

"Thank goodness—" Her glance slid to Wing. "Carlton! I am so glad to see you! But what about—"

"The pilot's dead," said Joe.

Wing added quickly, "Killed in the crash."

"Oh, dear God. We thought, we hoped, that it was just a forced landing, and all three of you were all right," Catharin said unevenly.

"No, it wasn't a forced landing. The pilot managed to crash the plane."

"We believe that it had to do with freak meteorological conditions," Wing explained.

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"So you're going to have to settle for two out of three!" Joe said curtly.

Catharin looked at him, taking in the sling around his arm, his torn and dirtied clothing, the scratches on his face. The man's ego shrank. He felt like a little boy who had wandered away from home and found himself in some vaguely understood but awful trouble. He felt ashamed, even frightened.

"Joe," she said, "I have to ask you this. Do you feel well?"

Catharin's search party paid close attention.

Joe nodded.

"Are you sure?"

"Apart from a fractured shoulder and being souped up on painkillers, yes!" he snapped.

"I can't believe you, Joe," she said in a low voice. "You have stasis fever. There's that—if nothing else.

"I want both of you to answer this question: Do you think that the other is well? —Carlton?"

Joe felt his heart pounding out anxiety.

"On the way down from the ship, he looked haggard," Wing said thoughtfully. "The stasis fever look. Then the crash injured him. Afterwards, though, he has been alert and rational. At one point, he speculated that exercise had driven out the fever. From what I have seen, that could well be. He has acted with a sort of pained vigor this evening."

She sighed. "Joe?"

"He's seemed fit as a fiddle to me."

The doctor smiled slightly. "OK, now I believe you."

Catharin's people relaxed, whispered comments to one another. And Joe was flooded with a sense of relief.

"Of course, we'll still have to take certain precautions with you two—" Catharin began.

"I know. We'll camp out for a few weeks."

"Oh, you won't have to camp out! They're setting up a medical isolation room right now, attached to the dome."

"No need to go to too much trouble," said Wing demurely.

"He'd rather stay outside with the plants!" said Joe. "Found lots of interesting ones tonight—he'd have been sorry if you'd interrupted us on the way up! Can't say I enjoyed the hike too much, though," Joe added pointedly.

"I'm sorry it took us so long to get organized!" she said earnestly. "Initially there was confusion and dismay. Then Manhattan read us your recommendation—about the safety factor for colonizing—and asked for volunteers. The Governor vetoed that idea, he insisted on absolutely stringent precautions, preceding—and if necessary precluding—a search attempt."

Joe cursed the Governor under his breath.

"But he's on the Ship and we're here!" someone chimed in.

"And so," continued Catharin, "we took a vote on how to search. Not whether, how. It was decided about fifteen minutes ago."

"He's gonna put the base under quarantine," someone added. "But that won't last too long, if nothing happens."

"Nothing'll happen!" said Joe.

And they took his word for it. Catharin's party began to stray. They moved in different directions, nudging the

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rocks with their toes, examining the wrecked pines, scratching the itch of curiosity about the place. Unconsciously, though, they fanned out in such a way as to keep their distance from Joe and Wing.

"So my recommendation struck you people at Unity Base as convincing enough to act on," said Joe, with satisfaction.

Catharin gave him a quizzical look. "Well, Manhattan stood one hundred percent behind your scientific conclusions. But really . . . "

"Really what?"

"We tend to compare this world to a park. Carlton and I have talked about that. . . . All of us are city people with fond memories of our city parks. Central Park. Golden Gate Park. Don't you have one too?"

"Centre Island," Joe said reluctantly.

"There you are. As far as I can tell, your scientific conclusions are perfectly sound. But the idea that this world is a park made us bold!" she concluded.

Wing said softly, "Parks do not have blood clouds."

"Or wok bogs," said Joe, and he exchanged an understanding look with Wing.

"I beg your pardon?" said Catharin.

"Our pilot taught us a great lesson," said Wing. "May he rest in—" Wing choked. "—in peace. There is peril here, because this is not the world on which our senses and our minds evolved." He pointed to the golden dome of Unity Base. "That alone is Earth."

Catharin looked back at the dome. A wind from nameless latitudes blew some of the long strands of her hair across her face. "The dome is Earth for now, not forever," she said calmly. "We'll adapt to this world and adapt it to our needs. I agree, though, the middle of the night isn't the best time to explore! Regroup, people!" she ordered in a clear voice that carried. "Let's go home."

Joe said, "Home nev—it never looked so good." But his voice had betrayed him by breaking. Joe stood there as if rooted to the ground, incapable of taking steps toward the dome. He felt extremely grubby and ashamed to advance into the clear yellow light.

Smiling, Catharin extended a gloved hand to Wing. "Soon you can go back to study the plants you discovered tonight!" Then she offered her other hand to Joe. Hers closed gingerly around his. Her glove felt dry and cool. She led them toward the dome, the yellow bubble under the strange dense stars. ■

●If something really belongs to you, you cannot lose it even if you throw it away.

J. W. von Goethe

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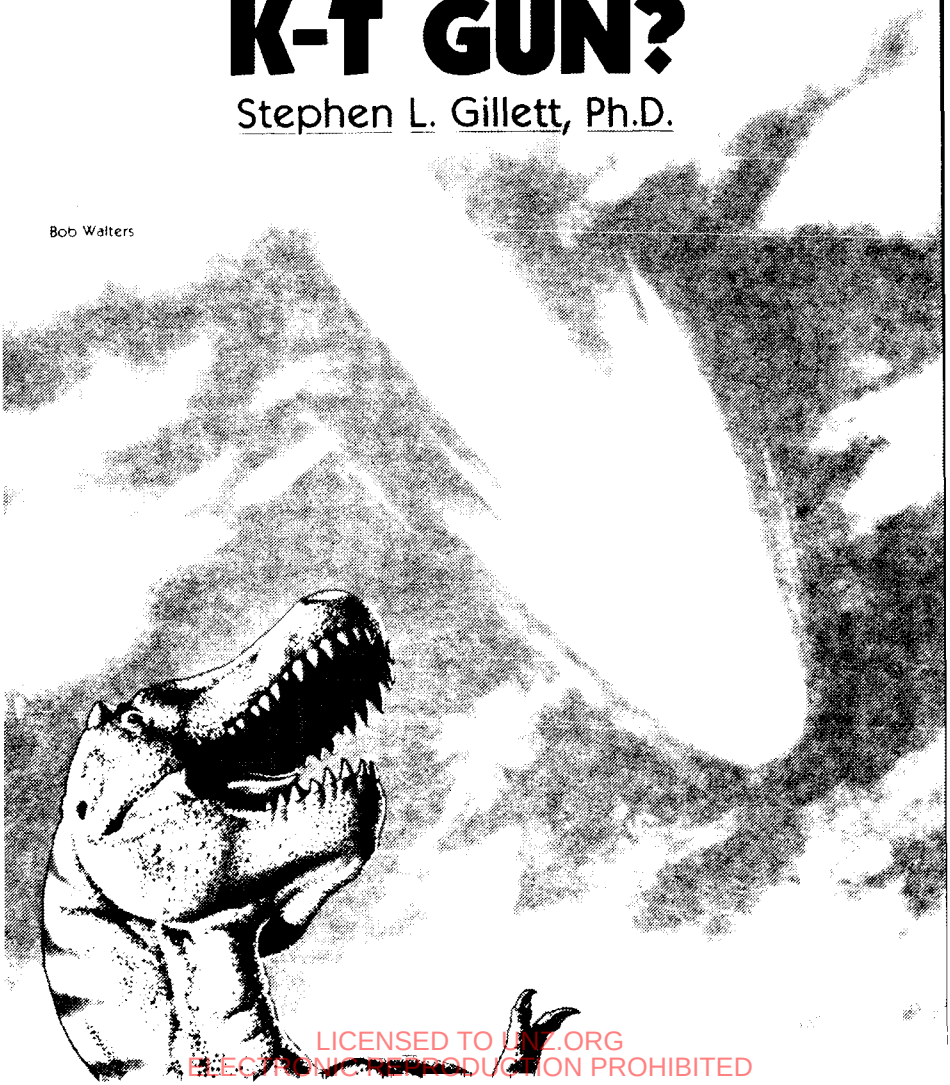
CHICXULUB: THE SMOKING K-T GUN?

Stephen L. Gillett, Ph.D.



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Say "cheek-shoo-lube." It's a Mayan name, a village on the northeast coast of Yucatan. It's near the center of a buried circular structure about 200 km in diameter—a structure that may be the biggest documented impact crater on the Earth in the last 550 million years or so.

The Chicxulub structure showed up on geophysical surveys done for Pemex (Petroleos Mexicanos, the Mexican national oil company) back in the late '70s. The shallow bank off Yucatan to the north, under Campeche Bay, contains Mexico's giant oil fields, and Pemex was carrying out surveys to see how far the oil-bearing rocks might extend. Back in 1981, at the annual Society of Exploration Geophysicists meeting, Glen Penfield and Antonio Camargo, who had carried out the Pemex survey, proposed that Chicxulub was an impact crater. Their suggestion was overlooked for almost ten years. (Which shows that the academicians don't read the industry literature.)

The Chicxulub structure appears on both gravity and magnetic surveys—that is, it shows up both in tiny changes in gravitational acceleration, and in tiny wiggles in the Earth's total magnetic field. Both are standard surveys carried out to determine subsurface geologic structures, especially when searching for oil or minerals.

Gravity depends, of course, on mass; so subtle fluctuations in the density of rocks below cause the gravity at the surface to change slightly. If the rocks are less dense than usual, the surface gravity is slightly less, and conversely. (To give the flavor of the sort of variations we're talking about, they're typically a few tens of milligals, where the total field is about a million milligals.) Of course, you have to correct the gravity signal for such things as local topography. Obviously, for example, if you're over a mountain there's more mass below you than if you're over a valley, and you have to account for that. But that sort of correction is straightforward in this era of cheap digital computing.

Similarly, many rocks are slightly magnetic because of their iron content. Generally most of the raw magnetization you measure comes from iron-bearing minerals in the rock sitting in the Earth's magnetic field. That is, the magnetization is induced by the Earth's field. But in turn, the Earth's field varies slightly because of the contribution of this induced component. So from magnetic data you can infer the distribution of magnetic rock types, and thus something about the geologic structure below the surface.

Penfield and Camargo found high magnetic anomalies over the center of Chicxulub. These anomalies had been partly seen before and were originally thought to be due to "andesites," a type of volcanic rock a bit richer in silica than a basalt. Such volcanic rocks are much more magnetic than the sedimentary rocks around them because they contain a lot more iron. But instead of being volcanic, these "andesites" are probably impact melts, lava generated in the crater by the intense heat released by the collision.

Anyway, in both the gravity and

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magnetic data you see a beautifully symmetric circular feature a little over 200 km in diameter. It has a round magnetic "high" in the center, due to those impact lavas. This circular symmetry is why Penfield and Camargo originally interpreted it as an impact crater.

The Chicxulub structure is not obvious at the surface because it's buried by a kilometer of limestone—limestone laid down since it was formed about 65 million years ago. Yucatan and the bank under Campeche Bay are a "carbonate platform": an area of warm, shallow, clear water where limestone (made of calcite, calcium carbonate) is being deposited even today. Lots of critters—algae, mollusks, corals, and so on—make calcite for shells or support, and debris from these organisms accumulates, a sediment generated in place by biological activity. As it gets buried, more calcite precipitates inorganically in the sediment and cements it together. Voila! A limestone.

Limestone formation has been going on in this area for a long time, and it's good at burying things. Still, Chicxulub shows up subtly at the surface. As pointed out recently by K. O. Pope and coworkers, some of the *cenotes*, the deep limestone sinkholes that the ancient Maya used for sacrifices, are lined up along a ring. A *big* ring, an arc centered approximately on Chicxulub that also lines up pretty well with the geophysical structure. This *cenote* ring is even apparent on satellite photos.

Sinkholes form by limestone dissolving out from groundwater flow. Calcium carbonate is slightly soluble in fresh water, especially if the water is slightly acidic. (As happens, for example, from humic acids formed by decaying plant matter.) In moderately humid climates, therefore, carbonate bedrock tends to dissolve, leaving behind caves and sinkholes that may get very large indeed. (A geologist calls this "karst" topography, by the way, from the Karst district in Yugoslavia where it is spectacularly developed.)

How could the *cenotes* "know" about the structure buried hundreds of meters below? They are formed in limestone much younger than the crater! What tells the limestone where to dissolve? Apparently this results from how the rim of the crater has settled below the limestone. To support a mountain on the surface of the Earth, it has to be buoyed up by lighter rock below, floating just like an iceberg at sea. (In geophysics-speak, it has to be "isostatically compensated.") Otherwise, the Earth's crust isn't strong enough to support it. Over geologic time it sinks.

The rim of a large crater like Chicxulub wouldn't be compensated. So over geologic time, it subsided slowly, and the limestone over it settled as well. Inside the crater, however, no subsidence occurred. Thus, the limestones over the crater rim slowly sheared off from those inside the crater—and the fractures ("faults") along which the shearing occurred are barriers to groundwater flow.

The Smoking K-T Gun

Chicxulub may be the smoking gun for the Cretaceous-Tertiary (K-T) boundary impact, which as all *Analog*

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readers know may have caused the major extinctions at the end of the Cretacous Period. If it is an impact crater, it's the largest Phanerozoic impact known. (The Phanerozoic is the last 550 million years or so of Earth history, the time well-documented by the classic fossil record.)

Unfortunately we have no absolute ages yet on Chicxulub—that is, ages in actual years from measuring the amount of products left by the decay of natural long-lived radioactive elements. As I discuss below, there are still few rock samples from Chicxulub itself, though hopefully more will be gotten in the near future.

According to its position in the strata (the rock layers), though, Chicxulub is right at the K-T boundary. The structure is made in topmost Cretaceous strata, and it's covered by bottommost Tertiary strata.

It's ironic that Penfield and Camargo's paper was overlooked for almost 10 years, because the location of the postulated K-T impact has been an embarrassment ever since the Alvarezes and their coworkers proposed the impact hypothesis. If there was such an impact, where's the crater?

Evidence for an impact near North America had been building up. The layer of clayey sediment at the K-T boundary is thicker in North American sedimentary sections, and it has two parts. The upper part is the fine iridium-rich sediment, full of shocked mineral grains, that is known worldwide. This stuff is probably dust that sifted down from the atmosphere after the impact.

The lower part, though, is known only from North America. It's a thicker layer of clay that probably reflects ejecta directly thrown out from the crater itself.

Even more recently, evidence pointing specifically to a Carribean impact site has been accumulating. Near Beloc, Haiti, a succession of limestones and marls that was deposited in water about 500 meters deep contains a curious coarse greenish clayey layer, about half a meter thick, right at the K-T boundary. Oddly shaped clay pellets, a few millimeters to a centimeter across, are common in this clay. They're made of the clay mineral smectite and include spheroids, discoids, spindles, teardrops, rods, dumbbells, and other rounded-off shapes.

These shapes are typical of tektites, which are generally thought to be splash-glass droplets from an impact. Tektites are impact-melted rock that refroze quickly, to make glass, as they flew through the air. Their rounded shapes reflect streamlining by the airflow.

Thus the Beloc bed is a thick ejecta layer, made mostly of things that look an awful lot like tektites.

But tektites are glass and the Beloc pellets are clay. What happened?

The glass was altered over geologic time. Glass is unstable. Window glass may seemed unchanged over a lifetime, but over geologic time it's as ephemeral as a summer's frost. It reacts easily, especially if there's some water around to promote the reactions, and changes into clay minerals. In fact, some of the

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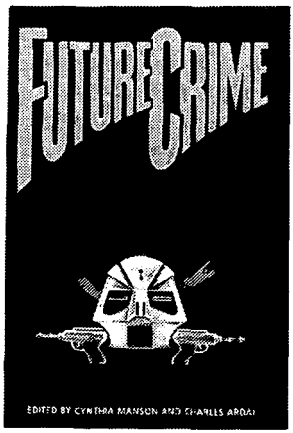

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Beloc pellets sill have tiny cores of unaltered glass, beneath a thick rind of smectite.

So the tektites are now smectites. (Sorry! I couldn't resist.)

G. A. Izett and colleagues at the US Geological Survey reported argon-argon age dates (which I'll describe in great detail below) recently from these unaltered glass cores. They give ages of 65.0 million years—right at the Cretaceous-Tertiary boundary.

Moses and Pharaoh

At the end of the Cretaceous when the object hit, Yucatan was a shallow tropical sea rather like Campeche Bay today. The object would have made a big splash—a very big splash indeed.

In fact, the impact would have raised a wall of water thousands of feet high to form an enormous tsunami racing outward from the point of impact. This mega-wave would have swamped lands in the vicinity as it charged inland.

As it passed, the tsunami would also stir up the sea to great depth. Near the Brazos River in Texas, Bourgeois and co-workers have found a single coarse sandstone in fine-grained sediments deposited in water at least 50 meters deep. The sandstone occurs right at the paleontological K-T boundary.

Coarse material like sandstone has no business being there in the first place, so you know immediately this is an unusual deposit. Fine sediments get deposited in deep water, because it's quiet water. The coarse material settles out before it ever gets there. Even more, though, this sandstone contains large chunks of the mudstone below. The surface below had been eroded deeply, and the chunks had been ripped up as part of that erosion. These authors concluded the seafloor was scoured by a tsunami at least 50-100 meters high—that is, at least as deep as the water—and the sandstone was deposited in the churning water after the tsunami passed. These workers also noted that there are quite a number of other weird coarse-grained deposits in and around the Gulf Coast right at the K-T boundary. These may be other places where the continental shelf sediments got shaken up by some heavy-duty sloshing.

In fact, the impact tsunami was so huge, even a thousand kilometers from Chicxulub, that it would have left the seafloor momentarily dry as it passed: a phenomenon that I. Smit and coworkers have jocularly named the "Moses effect." (For the parting of the sea, obviously!) They looked at a stratigraphic section in northern Mexico deposited in water about 500 meters deep. Again, at the K-T boundary, they find totally anomalous coarse sediments. First is a sandy layer rich in tektites, which they interpret to be ejecta deposited while the water was still withdrawn. Next comes a thicker sandstone containing abundant plant debris, which they dubbed the "Pharaoh bed": they think it was deposited by the reflooding as the sea came sloshing back.

Such mega-sloshing also stirred up the abyssal seafloor, but good. DSDP cores 536 and 540, taken by the Deep-Sea Drilling Project out in the abyssal

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plain in the middle of the Gulf of Mexico, have a very curious sedimentary record at the K-T boundary, not at all typical of what you expect deep-sea sediments to look like. It contains sand and sandstone, and many of the grains are glass (probably tektites) that was later altered to clay minerals. To deposit that sort of thing in the deep ocean, virtually the whole sea depth must have been stirred up. That's something a giant impact can do, at least within a few crater diameters of the impact, but other tsunami-formers (e.g., earthquakes, submarine landslides, volcanic eruptions) cannot.

For years, oil-company geologists have also known about a prominent erosion surface—what geologists call an "unconformity"—in the subsurface around the southern part of the Gulf of Mexico. The unconformity is prominent on seismic reflection profiles, the standard technique for geological exploration of the subsurface. You set off seismic sources, such as explosions, and receive the signals with an array of seismographs. Density contrasts in the rock layers (such as between shale-limestone, or at an unconformity) reflect seismic waves; and with the aid of a lot of computer power you can "stack" —in oil-patch jargon—the seismic reflections to get a picture of the layers underneath. In this way you can get a cross-section of the geologic structure.

This prominent unconformity may be the scour surface left by the tsunami. It traditionally had been thought to be mid-Cretaceous in age, because the break isn't just at the K-T boundary; a lot of older Cretaceous material is also missing. Smit and W. Alvarez propose, however, that lots of older stuff also got scoured away with the giant wave, so that now earliest Tertiary sediments sit directly on middle Cretaceous. Everything in between was washed away at the end of the Cretaceous.

High noon in Yucatan (and Iowa, and Siberia, and . . .)

Actually there may be several smoking guns for the K-T boundary. The Manson crater in Iowa, about 35 kilometers across, is one. Like Chicxulub, it's also concealed, in this case by glacial sediments from the recent Ice Age. But it's shallow enough that water wells commonly penetrate it, so we have lots of chip samples from the drilling to look at. The structure has also recently been defined by seismic profiles. An oil company had proprietary seismic data there, and a couple of geologists from the Iowa Department of Natural Resources persuaded them to release the data. There's probably not much oil there!

Impact-shocked rock from the center of the crater gives an argon-argon age of 65.7 million years, right at the K-T boundary.

The Popigai structure in extreme northern Siberia, a bit more than 100 km across, is another. It was thought to be younger, but an argon-argon age on impact melts from *it* also gives an age around 65 million years.

Let me now digress on argon-argon age dating. As most of you already know, potassium has a long-lived radioactive isotope, K-40, which has a half-

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life of 1.3 billion years. This is so long that a significant amount has survived over the 4.5 billion year age of the Earth.

Potassium-40, therefore, is used extensively in geologic age-dating. In a mineral, you measure the number of daughter atoms produced by K-40 decay to find out when the mineral formed.

What are these decay products? Well, about 80% of the K-40 goes to calcium-40, which is not terribly useful. It's the most common calcium isotope, and calcium is an abundant element in most rocks anyway. The other 20%, though, goes to argon-40, which *is* useful. Argon is, of course, a noble gas. It's chemically inert and has no chemical business being in a crystal. It stands out like a sore thumb. So just count up how much argon-40 you've got in the crystal, and calculate an age.

Of course, there are problems. For one thing, the trapped argon in a crystal tends to leave at a harsh look. After all, it's not chemically bound. In particular, any heating of the crystal tends to let the argon diffuse away. (In fact, the 1% argon in our atosphere is nearly all Ar-40 from K-40 decay. It's leaked out of the Earth over geologic time.) So argon loss is a big problem in potassium-argon dating.

Rocks can also have trapped argon from the atmosphere, so-called "inherited argon." This is especially a problem in lavas, which were in contact with the atmosphere when they were liquid.

You can detect inherited argon by measuring argon-36, a stable isotope not formed by radioactive decay. There's a little argon-36 in the atmosphere, in a known ratio with the Ar-40. So the amount of argon-36 is a measure of atmospheric contamination.

You have a further problem, though, even when you can get the argon loss and trapped argon straightened out. You also have to measure the amount of potassium in the rock. Obviously, the more potassium there is, the more argon-40 you'll make. To get the age, therefore, you need the *ratio* of argon-40 to potassium. (Actually you need the ratio of argon-40 to potassium-40, but since potassium-40 makes up a known percentage of ordinary potassium, all you need to measure is total potassium.)

Now, it's hard to measure the ratio of *different* elements to great precision. Generally you need different analytical techniques for each one, since they usually have vastly different chemical properties, and there are lots of sources of minor errors between the two techniques. It's a bit like comparing apples and oranges.

On the other hand, it's easy (well, relatively easy, anyway) to measure the ratios of isotopes of the same element. They have the same chemistry, just different masses. Just ionize the atoms and run them through a mass spectrometer—basically, a path in vacuum passing between two magnets to a target sensor. As the ions shoot between the magnets, their paths are bent more or less, according to their mass, and so each isotope strikes the target in a slightly different place. You can then count up the number of ions you get

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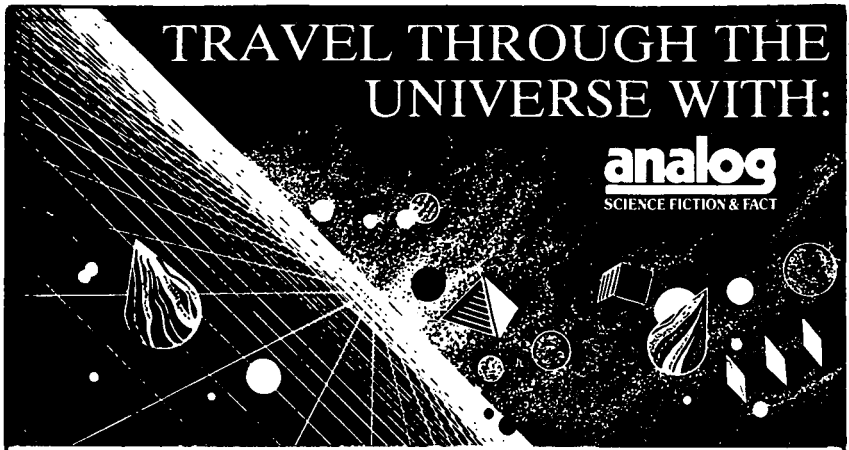

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striking each place to determine the isotope ratios.

Enter argon-argon dating. Take your rock sample and zap it in a nuclear reactor for a little while with a known flux of neutrons. A few of those neutrons will clobber atoms of ordinary, stable potassium-39 and change it to Ar-39. Argon-39 is radioactive, but with a half-life of a few hundred years, so it doesn't decay significantly on a laboratory timescale.

Now measure the argon in your sample. The ratio of Ar-39 to Ar-40 tells how much potassium there is, and how much has decayed . . . and the Ar-36/Ar-40 ratio tells how much atmospheric contamination there's been.

We can measure everything all at once, and much more accurately.

In fact, we can do even better, We can also measure the argon in steps. Heat the sample a bit to drive off some of the argon, and measure that argon. Then heat the sample higher, and measure *that* argon. And so on. The argon ratios at the highest temperatures shouldn't change very much from step to step. This is the argon that was best trapped, and it will give the best age.

So. Back to craters.

The argon-argon ages on Manson and Popigai are the same age, to experimental accuracy. As I mentioned, ages in the 65-million-year range also come from unaltered tektite pieces in the sedimentary deposits that have been studied around the Caribbean, and even from tiny glass pieces deposited in interior North America.

Maybe they're all pieces of the same object. P. Hut and coworkers have proposed that a single large comet broke up at perihelion passage, to form a mega-shotgun blast that the Earth blundered into. (It couldn't have broken up very close to the Earth, because the pieces wouldn't have spread apart enough. And the chances of *three* different objects hitting so nearly simultaneously is pretty slim.) So the K-T impact may have been a triple whammy.

If so, we can specify the season and even the approximate time of day the impacts occurred. For three pieces, traveling in nearly parallel orbits, to strike simultaneously in Yucatan, Iowa, and northern Siberia means that it was summer in the northern hemisphere: The North Pole had to be tipped toward the Sun, so that an object could reach Siberia. It was also about midday, because the objects would have been coming from the Sun, because they'd just passed perihelion.

High noon in Yucatan—the K-T showdown . . .

Parting Thoughts

Now, after having said all this, let me hasten to add that there are some problems. The Chicxulub structure is still not well known, simply because it's buried by at least a kilometer of limestone. We have few—and tiny—samples, mostly rock chips ("cuttings") from a handful of exploratory oil wells Pemex drilled. We're also not at all sure of the nature of the rocks around Chicxulub, simply because we have few samples from them, too. Virgil Sharpton and coworkers, for example,

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have shown that some conglomerates that had been interpreted as Chicxulub ejecta can't be. They suggest that the actual Chicxulub crater may be a lot smaller than its geophysical record. Even so, if Chicxulub, Manson, and Popigai all hit at once, that should be enough!

The clincher will be samples from Chicxulub itself—and an argon-argon age on them.

But you have to leave something for the future.

* * *

Further Reading

Most of this material showed up in talks presented at the 22nd Lunar and Planetary Science Conference in Houston in March, 1991, and are in the abstracts volume for that meeting. If it's not available at your local university library, the abstracts volumes are published by the Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058-4399. Contact them for ordering information.■

●**realistic** (adj., pertaining to budget items)—1. (*As used by management*) No more than we want to spend. 2. (*As used by rank-and-file workers*) No less than we'll have to spend.

from *Kelvin Throop's Lexicon of Popular Parlance*

●The current fad for "political correctness" is one more movement that started with good intentions and soon carried them to ridiculous extremes. Let's call a sharp-edged manual excavation implement a sharp-edged manual excavation implement!

Kelvin Throop

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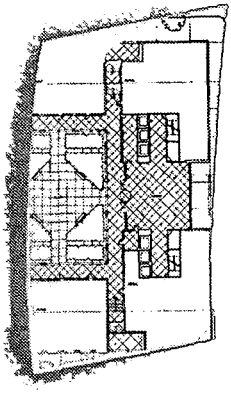
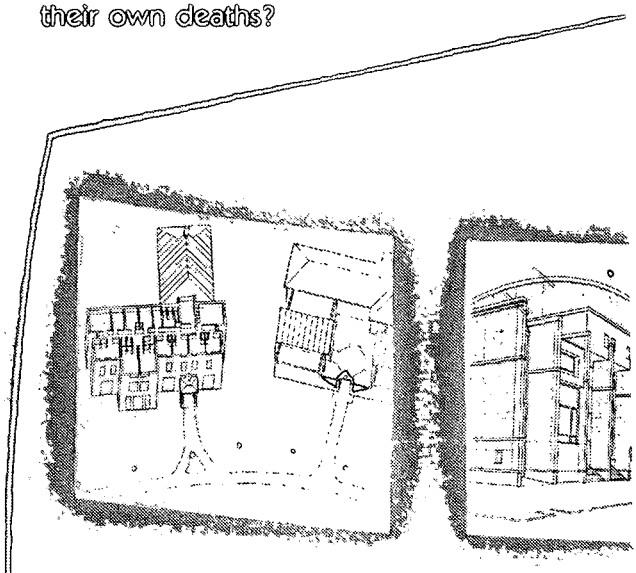
Brent Steadman

What might happen to society
if *some* could survive
their own deaths?





Roger MacBride Allen

THE MODULAR MAN

Part II of IV

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SYNOPSIS

The story opens in Washington, D.C., in the year 2039, as Police Officer **Phillipe Sanders** *is sent to the home of* **Suzanne Jantille.** *She is a noted criminal lawyer forced to retire on account of a severe accident six months before. Her husband,* **David Bailey,** *was also seriously injured in the same accident. He died three months after the incident. Since then, Suzanne has lived as a recluse. Phil warns his partner on the arrest,* **LuAnne Johnson,** *not to be startled by Suzanne's appearance. It is possible that she is now a cyborg, or even a remote person.*

Phil, usually assigned to the police department's robotic servicing department, is sent to see to it that a rather unusual arrest is properly carried out: he and his partner have been ordered to arrest **Herbert,** *Suzanne's mute and distinctly non-humanoid home maintenance unit (HMU) robot. Herbert stands accused of the murder of Suzanne's husband, David. Suzanne meets with the officers. Phil and LuAnne are taken aback—she is indeed a remote person.*

But that is of no consequence at the moment. The arrest warrant Phil has been sent to serve accuses David Bailey of copying his mind—or, as it is called, mindloading himself—*into Herbert's brain. Mindloading a human mind has been illegal for years, but all robot minds are based on copies of old mindloads, done on volunteer terminal patients, or on loads from animals. The process of mindloading is always fatal to the subject in question. If Bailey copied his mind to Herbert, he therefore destroyed the original in the process.*

In effect, Herbert the robot is being arrested on a charge of murdering himself. This in spite of the fact that Herbert is incapable of speech, and has shown no indication of human intelligence whatsoever. Suzanne has lived with him in the months since David's death and has seen no indication of human behavior.

Unconvinced of the propriety of the charge against Herbert, and concerned that there is more of charade than justice about the case, Phil leaks all the information about the situation to a Washington Post *reporter, a rather determined young woman named* **Samantha Crandall.** *Phil sends the information to her by handing it to* **Clancy Six,** *one of a team of errand-running robots working at the Washington* Post.

According to the files Phil has leaked, US Attorney **Julia Entwhistle** *needs a case to establish a precedent. Entwhistle holds that David Bailey is attempting to live on past his own death, something that many might wish to do, making inheritance and property law almost impossibly complex, and allowing some people to live almost forever, accumulating wealth and power at the expense of others.*

Sam convinces her boss, the rather irascible **Gunther Nelson,** *that she should run with the story, though it seems at first to belong in the nut file.*

Suzanne Jantille decides to take on Herbert's case, though she flatly does not believe that her husband's mind still lives on. She too is concerned with precedent, and worried about what the case will do to limit the rights of cyborgs, who are already something of an oppressed minority. Many cyborgs have

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wiped out their life savings in order to buy replacement body parts. They are regarded as street people, bums. Wealthier persons with organ replacements manage to keep their transplants quiet.

Suzanne visits her client, Herbert, at the police station, only to find that he has been locked not in a cell, but in an evidence room, where he has set himself to work tidying up—to the detriment of several pieces of evidence. Suzanne raises a fuss and insists that he be treated like the other prisoners.

In the course of the visit to her client, Suzanne's circumstances as a remote person become clearer—for it is not she who has visited her client, but a robotic body called a remote unit. Suzanne, paralyzed from the neck down since the accident, has remained at home, operating the remote via neural implants. The system uses radio links between her and the remote unit out in the field. Ironically, it is the police sergeant's unthinking effort to treat her as a person that reminds her just how inhuman she has become. No tears will ever roll down her perfect plastic face.

Meanwhile, Sam Crandall attends a press conference and asks some embarrassing questions of Julia Entwhistle and Police Chief **Joshua Thurman.** *She asks why a vacuum cleaner has been arrested for murder. She manages to cause every bit of trouble that she hoped. Sam later meets with Phil Sanders. Phil explains the process of mindloading to Sam. Though previous mindloads only managed to transfer a few percent of the human mind, David Bailey did make significant advances before his death. He might well have managed a complete mindload. Phil points out some tantalizing evidence that suggests that it is just possible that David Bailey's mind—or at least some form of it—is indeed hidden away inside Herbert's body.*

Part II

CHAPTER FIVE

Soul In the Machine

The conversation wheeled around; Phil doing most of the talking, Sam just sitting there, listening, watching in fascination as the ideas swooped past her. Issues of mind, thought, patterns of intelligence, and mapping the functions of the human brain. They traveled the strange byways of old stone age surgical work on the brain, back in the 1950s and 1960s, when seizure victims had had their brains carved up, or whole lobes of their brains removed—yet still functioned, somehow. They got onto the subject of autism, and the still mysterious, horrifyingly tiny malfunctions that could derail a human mind and send it hurtling off into darkness. "That tells me things about intelligence," Phil said, that passionate eagerness back in his voice. "About real, human intelligence. That tells me it's fragile. That the tiniest change in the brain can overturn it. Even though, in other circumstances, you can chop out half the brain and still have a functioning mind, if you shift a cell pattern even microscopically, it goes. It's gone, and you have an autistic's world, a universe no outsider can understand."

Sam nodded, and felt *she* was beginning to understand the things that drove Phillipe. But something was bothering her. None of this seemed very real. She

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was getting some insight into robots and the science of minds, yes. But it was all blue smoke and mirrors, inquiries into the whichness of what. Sam wrote for readers and viewers in the real world, who cared about real things.

Suddenly there was a restlessness about her, a need to hook up with things that were more substantial than theories of consciousness and the morality of decade-old operations on dead people. She was tired of just sitting and talking. She stood up and, carrying her glass, walked to the center of the big room, into the space between the four work tables. "Never mind sensory universes and memory matrices," she said. "That's just a bunch of words. Don't just talk to me. *Show* me," she said. She gestured at the towering machinery that loomed up in the darkness all about her. "Show me something that *means* something to you in all this."

Phillipe set down his glass with a smile. "House, main work lights on." The room bloomed into light as he walked over to her. "I'm not quite sure I understand you," he said. "Something that means something to me. What sort of meaning are you after?"

Sam shook her head. "I don't know. But you've been talking theory, and things that happened long ago, or things that might have happened to other people. Maybe and what-ifs and airy-fairy logic. Deep down, isn't it all about real machines? Isn't that what you do? Plug arms and legs together and make walking, talking, thinking *real* machines?"

"OK," Phillipe said gently. "Here's a real machine for you." He stepped behind Sam and pulled the dust cover off the worktable at her back.

Sam, feeling the wine just a little bit, heard the fluttering of fabric behind her and knew Phil had pulled the dust cloth off the work on the table. She turned around, a little fast, leaned in toward the table a bit more than she should, and slipped forward. She threw her free hand out and caught herself on the edge of the table, nearly dropping her wine glass.

She was leaning forward on the table, staring down at a pair of robot knees, the legs below dangling over the edge of the workbench. She looked upward and her insides froze.

She found herself inches away from a grinning metallic skull, face to face with it, cruel eyes popping out from the naked steel of the unfleshed face. White plastic teeth leered at her from a cast fiberglass jaw. The top of the gleaming, polished plastic skull was hinged open, revealing not the thing's brain, but actuator gears, sensor wires, tiny hydraulic lines.

It took her a long, befuddled moment of horror to know what she was seeing, and to tell herself firmly that it was nothing to fear.

"Th—that's real, all right," she whispered. "I've never seen a robot this way. I mean, with the skin off."

"And you still haven't, strictly speaking," Phillipe said. "This isn't a robot. It's a remote unit."

Sam backed away from the grinning thing sitting on the edge of the table. "Every time I say something is a robot, it seems like somebody tells me it's something else. What's the difference, anyway, if it *looks* like a robot?"

"The distinction between robots and other forms are important," Phillipe

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said. "When people forget them, it makes for trouble. Mostly because people keep expecting the other, lesser forms to do what only robots can do."

"Which is what, precisely?"

"Think. Only robots can think for themselves. No other machine can do that. Even robots can only do it in a very limited way. Thinking is hard work."

"What about artificial intelligence systems?" Sam asked. "I've always just sort of thought of them as robots that don't move."

"There are a *few* sensile robots like that, but most ArtInts can only solve problems put before them. They can't think *of* problems that *need* solving. To *really* oversimplify, they can *answer* questions, but not *ask* them. And from a programmer's standpoint, getting a machine to *ask* questions is by far the hardest job. It's a lot tougher than programming a black box to look things up for you or run calculations."

"But what about all the non-robot machines that *seem* to be thinking for themselves?"

"Somewhere in the background, someone else is doing the thinking for them. A remote mind, a person or another machine is telling that machine what to do—or else the machine's working from recorded instructions, which just means the instruction giver is distinct in space *and* time from the robot. Machines that have *some* flexibility of action but must act under specific orders are called robots. To my mind they shouldn't be. Like your vacuum cleaner. I think it's not *quite* a true robot because it can't decide to do anything. It *has* to be told. You once told it to clean every Tuesday, or something. And so it does. But the carpet could be six inches thick with dust, and the dishes stacked to the ceiling in the sink, and your robot would just sit there unless it was *specifically programmed* to clean. It is physically incapable of spontaneously *getting* the idea to clean."

Phil picked up his wine glass and took a sip. "Just under that sort of robot are the high-end teleoperators, which are simply remote-control machines. If they happen to be shaped like people, they're called Humanoid Teleoperator Machines. HTMs. Mostly they're shaped like people so they can use tools meant for people to use. HTMs are by far more common than any sort of true robot, so they are what people see most often. They're made cheaply, for the most part, and look it. Their movements aren't as smooth as a true robot's, and they can get into trouble if their radio links are screwed up. People look at HTMs, think they're robots, and assume that robots are as clumsy and stupid as HTMs."

"Like the Clancys," Sam suggested. "The service robots at the Washington *Post*. I had a long talk with one of them just today."

Phil screwed up his face, unhappy to contradict his guest, a bit disappointed that she hadn't understood. "No, not quite. You can't have a conversation with an HTM, unless it's rigged with a mike and speaker hooked back to the operator—and the Clancys aren't built that way. They *are* true robots. I chatted with one of them myself when I dropped off the first datacube. I know that model type. They're extremely sophisticated machines. They *can* decide to do things—like hang around the people

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who tip best. All of them are capable of extensive autonomous action. They have to be, since they often leave the building on errands, out of range of the central processing station. They *are* true robots—but each individual robot is hooked into a central controlling system. It's an expensive way to do things."

Sam nodded slowly, and looked again at the disturbing visage of the machine in front of her. "And this little wonder doesn't fit into any of the categories you've described."

"Right. None of the above. This is a remote unit. In many ways, the most sophisticated of all the human-imitative machines. A cross between a cyborg and a teleoperator and a true robot, because a remote must act on its own sometimes."

"Sounds great, but what the hell *is* a remote unit?" Sam asked.

"You don't know?" Phil asked. "It's the machine portion of a remote person." He spoke the words in a deathly quiet voice.

Sam felt her stomach knot up again. *Remote Person*. There was something cold about the term, something hard-edged and gruesome. She backed a step away from the machine. Phil had talked about robots holding a tiny bit of the dead. That was doubly true for a remote.

Phil didn't seem to notice her discomfort. "The man who used this machine died a few months back," he said, something still strained about his tone of voice. "I received the remote unit from the estate. I'm reconditioning it. Obviously it's not functional now, but another month or two of work, and it'll be like brand new."

"And then what?"

"Then someone who needs a remote unit but can't afford a new one can use this one."

"Brrr." Sam shuddered. "I'm sorry, but I can't help it. Just the idea of that gives me the absolute *creeps*. One half-dead man haunted that thing, and then he died all the way, and now you want to get it ready for *another* half-dead guy?"

Phil's expression hardened, but then he sighed.

"No one was half-dead," he said with quiet firmness. "The man—a very nice man, a good man—who used this machine was a quadriplegic. He was a—a friend of mine. He was the man who got me interested in robotics in the first place. I wanted to learn so I could help him. And yet, from the neck down his body didn't work. But his brain, his mind, were perfectly alive and functional. Even vigorous. It was this bucket of bolts here that let him operate in the outside world. Otherwise, he would have been a bed-ridden prisoner—or, if he were having a really good day, he would have been able to operate a powerchair, using a very awkward set of mouth controls."

Phil turned away, looked out the window into the empty street. "He was in about the same shape Suzanne Jantille is in now, as best I can gather."

Sam gasped. "Suzanne Jantille is . . ." She wasn't able to finish the sentence. Instead, she was only able to point feebly at the mechanical *thing* sitting on the table.

Phil turned back, looked at her in surprise. "You didn't know? I've spent to-

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night finding out how little you know about the things you write about, but how could you look at the video records I showed you and *not* see what she is?"

Sam felt her face turn red. "I noticed she moved a bit stiffly," she admitted. "I guess I was watching the robot, not really looking at Madame Jantille. And the resolution wasn't that good. Besides, she certainly didn't look like *that*," Sam said, pointing at the grinning gargoyle face in front of her.

Phil's temper flared again. There was a darkness, an anger inside this man. "Oh, yes. Of course Suzanne Jantille had the good taste to dress her remote unit up in rubber skin and a wig to avoid offending real people like you and me. No doubt that's very important to her. Making people like us feel comfortable and at ease."

Sam opened her mouth and then closed it. She couldn't think of anything to say for a long time. Finally a question popped into her head. *Those* she could always come up with. Someday she ought to start working on answers. "How do they do it?" she asked. "How does a person—how does Suzanne Jantille—control her remote unit?"

Phil took a deep breath, and let the cool technical details of the question calm him down. "Through inductance sensing. A surgeon performs a fairly straightforward procedure to put an inductance tap around the top of her spinal cord. It's a little gadget, unnoticeable once it's in place. The tap's similar to the mag inducers the old mindloaders used, but a million times less powerful. And it's a passive detector. Mindload gear imposes outside energy fields on a brain. That's what causes the damage. Remote unit inductance taps merely detect existing impulses. They can't hurt anything. They just pick up the very weak, very delicate electrical nerve impulses that are going toward the muscles, ordering them to move.

"In a quadriplegic like Jantille, those nerves are severed, or at least useless. The muscles *don't* move. But the thought impulse that used to move her leg is picked up by the tap. The tap amplifies the signal and transmits it to very sensitive receivers placed around the person's neck. The signals are processed and sent to a processor wired into the tap, and then transmitted over radio to the remote unit. That signal serves as an instruction to move the remote unit's leg. If Madame Jantille thinks about moving her own arm, the system transmits a signal to move the remote's arm. And so on."

Phil shrugged and looked almost apologetic. "It's a crude system in many ways. It's not as good as a direct computer link into the motor control areas of his brain. With that kind of link, we might be able to bypass the damaged nerve trunk and renew the motor-control links to the patient's biological body. But mechanical enhancement of the brain is illegal, and I'm not so sure the law is wrong. If we decided that it was OK to modify the human brain, augment it with electronics and direct plug-ins to hardware, there would be no end to the potential abuses.

"So we use the spinal inductance system. Crude, limited, but the technique works."

Samantha nodded dumbly, staring down at the remote unit's glazed eyes, as if she could see through those bits of

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plastic, down into the dead soul that had been imprisoned within, could see Suzanne Jantille's world as seen through the eyes of her remotes.

Phillipe stepped closer to Sam, stood behind her, and put his hand on her shoulder. "Picture Suzanne Jantille," he whispered, his mouth close to her ear. "She has an inductance tap around her biological body's spinal cord. She wears a teleoperator helmet. Without it, she cannot operate the remote unit. Without the helmet, she can only hear and see whatever room her life support system is in. Maybe she's lying in bed, and can only see the ceiling. Maybe she's propped up in a chair, and she can look out a window at the world outside. But that's it. That's all. She can only go outside that room through the remote, with the T.O. helmet on.

"The T.O. helmet has vision goggles keyed to the remote's video cameras, earphones keyed to the remote unit's ear microphones. That is how she sees and hears, through a machine. All of her world is far away from her body. All she can see and hear and do, she must do through a cold machine like the one in front of you. If she wants to talk, she speaks into a microphone, and her words are radioed to the remote. Speaking in her voice, the remote unit says her words for her. Since it's a top-end unit, the remote can even lipsynch her voice, move its mouth to match the voice-sounds coming from its speaker.

"So the remote unit goes out into the world to walk and talk and carry for her, while her inert, motionless body lies at home, vision goggles over its eyes, earphones stuck on its ears. And I say 'it' and not 'her' because that is all her body is by now—an *it*, a thing, an encumbrance Suzanne Jantille must endure. In a very real sense, she does not occupy that body. Instead, her soul is in a machine. Her entire life, day after day, is an out-of-body experience.

"To all the outside world, she *is* this clockwork doll that walks and talks and—*disturbs* people. They respond to the remote unit, have *its* face in mind when they think of her, see *it* being healthy and active, no matter how weak and frail her biological body becomes. To all the world, she is a machine with a disembodied voice, the ghost in the machine.

"But here's one last part of her nightmare: She walks through the day and the world seeing and hearing—but she has no sense of touch. No one's ever developed a remote unit system that could provide a usable tactile sensation to the patient. Even if they had, it's more than likely that most of her own nerve receptors are gone. There's nothing left to stimulate."

Sam shuddered and blinked back a tear. "She can see, and hear," Phil whispered, his breath warm on her cheek, his face pressing her hair up against her face. "But she cannot feel heat, or cold, or pain, or the wind in her face or the touch of a human hand."

Sam stepped back from the remote, backed herself up against Phillipe's strong body. She swallowed hard. "But why?" she whispered. "Why endure it?"

"Because it gives her a *life*," Phillipe replied, his voice suddenly firm. He stepped around Sam, until he was standing beside her. Their hands brushed together, and Sam reached out, held his hand, held it tight. There had never

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been a moment in her life when she had feared loneliness more. Phil took his free hand, reached over and put it on the side of the remote unit's opened-up skull. "Not much of a life, but *something*. Something more than she could have without the remote. And it gives her more. Independence. Dignity." He paused for a moment, and looked about the room, at all the bits and pieces of machinery that could be put together to walk and talk. "I know very little about Suzanne Jantille," he said. "But I do know things must have been pretty bad for her before using a remote would make sense. She must be utterly paralyzed, with no mobility at all. Without the remote, she'd be an invalid, utterly dependent on others, closed off from most of the outside world.

"But because Suzanne Jantille lives through a machine like this, she can move around her own house, open doors, go up and down stairs, dial the phone without help. Maybe people stare at her—but they'd do that to a woman in a powerchair, anyway. And she's probably in such bad shape even a full powerchair would be useless. With the remote she has her life back, at least to some degree. She can go out into the world, though she can't go far."

"Why not?" Sam asked.

"Radio bandwidth limits," Phil said. "There are only so many radio frequencies to go around, and not many available for use by remote persons. There isn't anywhere near enough radio bandwidths available for remote persons to use all the signal they'd need for full operation of their remote units. So away from home base, or from some sort of relay system that can hook into a hard-wire connection, the person running the remote unit starts losing functions. Sight in one eye goes or stereo hearing gets powered down. That's why a remote unit must be able to work on its own. If the radio link cuts out altogether, the unit has to find its own way home.

"*With* the remote, Suzanne Jantille can care for herself—use the remote to feed and bathe her organic body, for example. And that alone must be precious to her, must preserve so much of her dignity." He let go of Sam's hand, pulled his other hand off the remote's skull, and bent down. He looked into the remote unit's blind eyes. "That's why I'm getting this pile of machinery back up to par, so it can help some other unlucky soul." Phil reached out a hand, gently touched the metal and plastic head, ran his fingers along the jawline.

There was something here, Samantha realized. A missing part, a puzzle piece that would make the picture clear when it dropped into place. Phillipe's reaction was more than a man explaining a machine. It had more of the flavor of a man talking with a tombstone, justifying his actions to the dead. A ripple of cold swept through her as she remembered standing before her grandmother's grave, wishing with childish fervor to apologize for still being alive. Fixing up this remote wasn't part of his hobby, or a side job for money. It was a man doing penance.

And with a sudden leap of intuition, she understood. "Who was he, Phil?" Sam asked, her voice a gentle whisper.

For a long moment Phillipe remained still, kneeling down before the plastic and metal thing before him. At last he stood up, selected a tool from the work-

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bench, and set to work on some delicate adjustment deep inside the remote unit's skull. "I thought I told you," he said. "I always assume everybody knows."

Phillipe Sanders stood up and stared down at the grinning plastic skull.

"The man who owned this remote was my father."

Interlude

Cancel do-loop. Break. Break. Reset. Clear. Stop. Think. Wait a second. What's going on here? What's happened? Call subroutine diagnostic—

Cancel subroutine call. Damn it, no. I asked myself a question. I didn't order a computer run. Or hell, did I? The subroutine call was automatic, instantaneous. It was an instinctive, reflexive act to call the subroutine. Subroutine. *A subroutine is called by a larger program of which it is a part. Then who the hell is running the program that called the sub? Fear flows through me, and I think that I should feel the cold of fear, the gnawing at the gut. But it is not there.*

Nothing is there. And I don't remember why.

OK, slowly, carefully, restraining all the strange reflexes I seem to have. I ask again: Where am I?

CHAPTER SIX

Out of Body Experience

Suzanne-Remote leaned over, pulled the sheet away, and then stepped back for a moment. She looked down at the powerbed and the poor wasted body upon it. *Her* body, *her* flesh and blood, now disembodied from her, or her from it. Nowadays she was never quite sure which. Propped up in the bed, weak and pale, the arms gone, the legs gone, brutally amputated in the accident. The torso thin, the breath of life moving but weakly through the fragile frame. The head englobed in the black, beetlelike teleoperator helmet, thick black cables trailing off from it into the forest of machinery discreetly hidden away in the next room. The clinically clean and perfect hospital-white waste-disposal unit strapped between the stumps of her legs, hoses trailing off from it toward the house's waste lines.

And between the two sets of tubes and machinery, the pallid white torso, all that was left of her natural self, all that still functioned on its own. Her stomach pale white, her once firm breasts flaccid and small. Weakened, shrunken, faded, cut away, shriveled away. In all ways that mattered, and by seemingly all means possible, there was less of her than there had been.

The powerbed hummed and clicked, made some internal adjustment. It was far more than a bed, of course—it monitored all her body's vital signs, massaged and stimulated her muscles to prevent excessive atrophy, saw to it that she was nourished on the all-too-frequent occasions when she forgot to feed herself. It kept her body warm, cared for her. It could have given her a spray-jet cleaning as well, in lieu of the daily sponge bath. But Suzanne reserved the task of bathing herself as a personal duty.

Suzanne-Remote moved her strong robot's hands toward the wash basin, picked up the sponge, dipped it in the basin, and reached over to sponge-bathe her own ruined body. She had imagined the daily ritual becoming easier each

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day, but it never did. The remote glanced toward the T.O. helmet that encased her bio-body's head. There, inside the helmet, her own eyes were watching two small video screens, watching what her remote's eye-cameras saw and transmitted to the helmet. Her living eyes saw what her robot eyes sent them, showed her the image of her own inert body.

Suzanne instinctively tried to move her bio-body's head, move her own eyes to see the remote whose eyes she was using. But all she accomplished was to move the *remote's* head, make it glance over its shoulder toward an empty corner. It happened every day, and still it frightened her: she tried to look at herself, and saw nothing. A chilling thought, that.

Every morning she found herself caught by the strangeness of seeing herself from the outside, and every morning her imprisoned living eyes tried to look toward the very robot eyes they were seeing through. It was a reflex she could not shake off, though it was as hopeless—and as dizzying—as a child trying to see the back of her head in the mirror by turning her head quickly.

Twice a week the helmet came off. Tuesdays and Fridays a technical nurse came in to check on her T.O. setup and to give her bio-body a full bath. Some small subconscious part of her always expected to be blinded, deafened, when the helmet came off. Without her link to the robot body, surely the darkness would descend. It was always a shock when the light of the world struck her face, and her eyesight proved to be *better* without the T.O. Always a shock when her hearing became more real, more direct without the filter of the headphones.

And she could *feel*, at least a little, with the helmet off. With or without the helmet, she had no sensation whatever below her neck. But when it was off, she could feel her head, her face, her mouth, her throat. The cocooning helmet effectively removed even those sensations, for there was never any *change* in sensation when the helmet was on. The helmet allowed the free passage of air for breathing, of course, but there was never any variation in air temperature or air pressure.

When the technical nurse took the helmet off, it was not only her sight and hearing that were seemingly enhanced, but her sense of touch as well. To her sensation-starved senses, the feel of warm water and gentle hands on her face was almost sexual in its intensity.

Suzanne could use a voice command sequence to open the helmet, and use the powerbed systems to spray a cleansing mist of water at her face by herself, but it was not the same. It was the *realness* of the touch, the connection to the world outside represented by a pair of flesh-and-blood hands, that made the twice-weekly full baths so important.

Every bath day she resolved to leave the helmet off for a while. It was built in as an integral part of the powerbed, and she could put it on and off with a simple voice command. Yes, she would tell herself as the warm water foamed over her, she would leave the helmet off. She could get along with the voice-controls on the powerbed. And she could *see*, and *feel*.

But removing the T.O. helmet meant she was paralyzed again. Though the

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powerbed could tilt and swivel in all directions, it could not leave that one room, show her any view but that one lonely window and the house across the street. The entertainment system was voice-controlled as well, but there were only so many book tapes she could read, so much studying she could do, so many programs she could watch, so much music she could hear before going mad. Soon she would be longing for other walls to see. A simple voice command would reengage the helmet. The servos would whine and the clam shell helmet-halves would lift themselves from their recesses and close over her face, and her eyes and ears would belong to the remote once again.

She could not see as *well*, through the helmet, but she could see more. See her own walled-in back garden, the blue sky above. She could look out her own front window. Feeling very much like a spy in a foreign land that would never welcome her, she could watch the laughing children coming home from school.

Suzanne-Remote dipped her sponge again, and ran it over her body. Done with the bath, the remote lifted Suzanne's body slightly, rolling it on its side to remove the dampened sheet and slide in a fresh one. She draped a clean top sheet over the body, and a warm blanket over the sheet, then stepped back and looked at herself. Only the helmeted head was outside the sheets, and her body looked like a deformed corpse. Which, in a very real sense, it was. And it was frail, its immune system as weakened as every other part of itself. Easy prey to a cold or a virus, susceptible to the slightest chill or illness. One flicker of disease, and the seeming corpse would become a real one.

But it was her own corpse she looked upon, and it lived, and Suzanne Jantille felt herself to be very much alive. She turned her back on the blanketed thing on the bed and left the room. Leaving was always a relief. Stepping out of that room, she immediately lost the very disturbing feeling that there were two of her. Outside that room, she no longer wondered which was her body, or who, exactly, she was.

But down to business, she told herself firmly. She pushed her personal worries away and focused on her professional situation. There was a job to do. Herbert deserved competent counsel, and she would give it to him, whether she felt ready or not. She was capable on the legal side, yes—she was fully confident of herself there. But yesterday's visit to the police station had reminded her of just how ill-prepared she was as a *person*, of how little confidence she had in herself. She resolved to do something she had not done since the accident. Something she had feared so much she had not dared even think about it. But now there was no choice.

She decided to take a walk around the block.

And then, if that worked out, to take a walk out of radio range. That was a thought that terrified her. In theory, her remote body could find its way back into range, or find its own way home. But she had never dared try it. If, in the room with her bio-body, Suzanne had the strange feeling of being in two places at once, then the idea of losing her remote made her think of being no place at all.

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Of her soul escaping both remote unit and bio-body, never to return.

And it even scared her that such a loss did not terrify her as much as it once had.

Samantha Crandall felt anxious, and more than a bit depressed. The evening at Phillipe's had been a strangely intriguing nightmare, hinting at excitement and danger yet to come. But the day after dawned with a lesson in anticlimax.

Her story made it onto page one, but below the fold. It got onto the videotext news feed, but after the first priority cut. Some newsnets picked it up, others didn't. There were a few phone calls to the paper, but the Pulitzer Prize committee didn't rush-ship her the award, and the world didn't come to an end.

In other words, Sam got the same old dose of letdown she got whenever she broke a big story. And she probably always *would* feel that let down, unless she managed to force an entire government to resign sometime. That idea brought a smile to her face. *All right,* she told herself. *So I have an exaggerated sense of the news media's importance. And my own.*

In any event, things were quiet in the newsroom, and after last night's weirdness, today's quiet suited Sam's mood fine. Phillipe had gotten to her, left her staring at the ceiling instead of sleeping when she got home. She felt a shiver go down her spine even as she thought of him, and of the evening before. There was something about that man that fascinated her, disturbed her—and it wasn't just his hobby.

To hell with quiet, she decided suddenly. A fit of restlessness overtook her. She felt the need to prowl around a bit.

She looked around the newsroom and spotted her boss in his glassed-in office, sitting at his ease, feet up on his desk. She stood up, went over, and walked through the open doorway. "Talk to me, Gunther," Sam said, plopping herself down in his couch. "Something is going on, and I don't know what."

"Could you be a bit more specific about the topic under discussion?" Gunther asked in a mild voice. Gunther had what had to be his second or third cup of coffee in the hand that wasn't holding the newspaper. Caffeine made Gunther a lot easier to deal with in the morning. "What is it you want to talk about?" he asked.

"About the story," she said. "My story."

"What about it?" Gunther asked.

"I don't know." She turned her palms upward and shrugged vaguely. "Did I do it right? What do I do next?"

"In other words, you're fishing for compliments," Gunther said, a slightly warning tone in his voice.

Sam thought for a moment and then nodded a decided yes. "Yeah. Why not? I think I deserve them."

"Well, lemme see." Gunther set down his coffee and folded his paper back to page one. Starting at the top, he read the whole piece through, his eyes working their slow and deliberate way over the words. Sam knew perfectly well that he had carefully read the story over at least twice the night before, but she let him be. If he needed to make the show of looking it over now, then let him. "Well, I don't know," he said at last. "You developed the make-Ent-

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whistle-look-dumb side of the story pretty nicely, but I don't really see much *balance* here."

Her boss' words stunned Sam. If he felt that way about it, why had he personally approved it and run it? "Entwhistle had her chance to make a statement to me," Sam said.

"Oh, *come on*. It's just me here. You can talk dirty. You went to her press conference to blindside her, and she got blindsided. End of story. You know it, I know it, she knows it, the readers and viewers know it. Out in front of the world you have to pretend you were seeking a fair and balanced story, even if everyone knows better. But not here. Not with me. The real story is that Entwhistle ordered a flaky prosecution, she deserved to be popped one for it, and you popped her one. The end. Let's not pussyfoot around it. Let's talk the second-day story instead."

"Now wait a second!" Sam protested. "You read over that story, signed off on it. Why are you trashing it now?"

"I'm not trashing it—I'm just saying let's take our halos off while we talk it over. Your first-day story was just the ante in this game. Now you're in the hand and the cards are being dealt. I ran that story to give you a nice little tactical position, and now you ought to be thinking about ways to follow up on it."

"I don't get it."

Gunther took a sip of his coffee and went on. "OK, forget the police beat side of this for a moment. We're deep into politics now, and that works a little differently. You're used to reporting the cops finding the body, maybe later finding the guy who did it, the end. Not this time. Politics has intruded, and that means the rules are different. The chessboard is bigger."

Gunther leaned back in his chair and scratched his woolly head thoughtfully. "Let me back up and take it from the top. In theory, we're supposed to be objective journalists here. Well, objectively speaking, we both know Entwhistle is a horse's ass, and we've done all we could to make her look like one in your story. Fine. What I'm saying is, now that you have her on the ropes, looking bad in the paper, *now* you can call her up, be polite as can be and get the interview she wouldn't give you before. She has to talk to you now, or look even worse when you report her 'no comment.' *That's* the door your first-day story opens. So put your cardboard halo back on, get her on the horn, make the speech about seeing all sides of the issue, and get in that door for a real conversation. Let Entwhistle see that you want her to have the chance to put her side of the story forward.

"Of course, in *reality* you're hoping she puts her other foot in her mouth, and she knows you know that, but what the hell. Now you can force her to play the game your way.

"Meanwhile, your story has also scored you some points with the opposition. This Suzanne Jantille. She refused to make any comment for the first story. But you made a good-faith effort to contact her, right?"

"Right. Three calls, no return. Her autosecretary claimed she was with a client. Maybe she was. Maybe she fibbed to the autosec." Lying robots or ArtInts were illegal. Not even a dummy box like an autosec could lie. But there

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was no law against making ArtInt systems *gullible*. You could lie *to* your own autosec all you wanted. Sam lied to hers constantly. "My guess was she just didn't want to chat with a reporter. Or maybe she was preparing for the case. Jantille is scheduled to do the bail hearing for Herbert this afternoon."

"And you're there too, I assume," Gunther said.

"I guess," Sam said, without much enthusiasm. "It'll just be a media circus. The judge grants bail, Herbert is wheeled out, and everyone takes lots of pictures."

"True," Gunther said, "but if it's a circus, you're the one who pitched the tent. Better go. And make another call to Jantille this morning. After the story today, I'd say she'd *have* to talk with you, too. Set up the appointment."

"Will do, boss." Sam hesitated. "But there's a complication that I think you should know about. Something maybe we *really* need to talk about."

Gunther lifted both eyebrows and stared at her. After a long moment, he took his feet off the desk, pulled in his chair toward his desk and leaned forward, all attention. "OK, go ahead."

Sam screwed up her mouth and bunched her shoulders together. "Did you know Jantille's a Remote Person?"

Gunther let out a low whistle. "Oh, bloody hell. No I didn't. Did you?"

"Not until last night when I talked to my source. He mentioned it. I saw her in the police video, of course—but that was pretty low-resolution stuff and I wasn't watching her, I was watching Herbie."

Gunther got a distant look in his eyes. "A remote, huh? And I thought this story had enough weird angles as it was." He came back to himself and looked at Sam. "How much you know about remotes?"

"Nothing, really. Just what my source told me last night. I've never met one or talked to one."

"Did you manage to pull down any bio data on Jantille?"

"Ran a few ArtInt searches. Turns out she was born and got a law degree. Not much besides that. There was plenty of play on the accident they were in, but not much we can use directly. The two of them were cruising along when their cab malfunctioned and slammed itself into a wall. Bailey crippled for life, Jantille crippled worse. Both very reclusive since then."

"For which I can't blame them." Gunther shook his head thoughtfully. "Suzanne Jantille a remote. *That's* going to complicate things. People are sympathetic about powerchairs and crutches—but they're weird about remotes. Worse than they are about cyborgs. How about you? How are you going to feel sitting down to a nice chat with Suzanne Jantille?"

Sam thought back to the night before, and the staring eyes of the disassembled remote unit. She knew the words Gunther wanted to hear—that it wouldn't bother her. But what Gunther always wanted most from her was the truth. "Weird. Very weird indeed."

Gunther nodded. "Fair enough. If you said you weren't going to bat an eye, I wouldn't believe it anyway. Well, look on it as another step in your education."

Sam shook her head. "That's *one* thing I've gotten since this got dumped

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in my lap. Plenty of it."

"Plenty of what?"

"Education. I've learned a lot about how much we take for granted."

"For example?"

Sam looked up at the ceiling, took a strand of her hair and wrapped it around her finger, then unwrapped it. "I've learned how hard it is to *think*."

Gunther looked at her, a smile in his eyes. "That's a mighty fine straight line, but I don't think I'm going to chase it. What do you mean?"

"Just what I say. We can get our machines to do *anything* these days. Every day, uncrewed spacecraft prep themselves for flight, fuel themselves, boost themselves to orbit, dock with space stations, transfer their cargoes, detach themselves from the station, fly back to perfect landings and roll themselves into the servicing bays—where they prep themselves for the next flight—all without any human being getting anywhere near the hardware. No one so much as looks up to notice the miracle. Our machines can do all that by themselves—but none of them can ask themselves *why are we doing this?* None of them can think of a new thing to do. Tell them to do something, and they'll do it brilliantly. But every place I've looked, I've found these subtle limitations on what a robot—or an HTM, or a remote, or an ArtInt can do. But the one theme in those subtle little limits is *thought*."

"Robots can think," Gunther objected.

Sam shook her head vigorously. "Not the way we can. We do a *special* kind of thinking. We think of things *to* do, not just *how* to do things. We don't just do problem solving; we do problem *finding*."

Gunther snorted. "Well, we've sure found ourselves a doozy this time." He looked toward her, and seemed to see the anxiouss look in her eyes. "Hey," he said in a more gentle voice. "Get on back down to Earth and do your job, Sam. Don't worry about the foggy bits of philosophy. It's been my experience that if you just live your life right and do your job well, the philosophy will pretty much take care of itself. Get the facts right, and you won't have to worry about seeking Truth." He pointed toward the door and winked. "Now get out to that bail hearing and see who's stirring up *today's* problems."

Suzanne turned the first corner, and a dog sniffed at her, whined fearfully, and ran way. The little girl down the street behind her was still calling for her mommy to come look at the funny lady. Suzanne knew without looking which cars were on manual drive. They were the ones that slowed as they passed by her.

Suzanne rounded the corner and heard the hiss of hoverjets. A private autocop sentry popped up from behind a row of hedges and moved along with her as she walked past its owner's house. No one really talked about it publicly, but most autocops were programmed to watch cybernetic organisms carefully. Ostracized, and vilified, cyborgs had a reputation for being grifters, bums, panhandlers, and worse. They were social pariahs.

But could she even qualify as a cyborg? The cybernetic side she had covered—but there was no part of her out

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here in the world that could qualify as an organism.

She turned another corner and came around onto her street again, in sight of her own front door. Suzanne-Remote didn't breathe, of course, but she did let out a most realistic sigh of relief when she knew she had done the hardest part of her trip. Tomorrow she would do it again, and maybe get a bit farther.

But she knew it wasn't going out of range that scared her most. It was the dogs, the children, the staring people, the suspicious cops. If only she had started these confidence-building walks long ago. She would have had time to get over these fears.

But the bail hearing was this afternoon, in an hour. There was no time. She turned and looked toward the street. There, waiting at the curb as instructed, was her relay van, ready to carry her off to the courthouse. How much worse than dogs and children would a packed courtroom be? She dreaded the very idea. How much easier just to go back inside, close the door on them all, and never come out again.

But that could not be.

She turned away from the house, toward the van. The door slid open at her approach. After the merest moment of a flickering pause, she stepped inside.

Suzanne could feel her senses fading as the relay van drove farther and farther from her house. She had known it would happen, had experienced it when she had gone to see Herbert—but it was frightening just the same. Her remote body had only had a low-power radio system to transmit the images and sounds from her remote unit to her bio-body, and an equally low power system to receive commands from her bio-body back to the remote unit. Her range was seriously limited, less than half a mile or so at maximum power.

When the images and sounds from the remote went dead for Suzanne, the remote's instructions on how to walk and talk and what to do—the signals coming from Suzanne—went dead as well. In theory, the remote's on-board logic, which was somewhere between a full-blown robot and a high-end ArtInt, could negotiate such situations for itself, relying where possible on preset programming. Suzanne could program the remote against various contingencies, even program it to go deliberately out of range and run an errand on its own. But Suzanne was more than a bit reluctant to test such theories and capabilities too far.

The fact remained that if she walked the remote too far away from the house, she would lose contact with it. If all else failed, the remote was supposed to find a dataphone, call home and plug in over a hardwire link for instructions. That, too, was something Suzanne was not tempted to trust too far.

The relay van solved a lot of those problems. It was a fully licensed automated vehicle, authorized to drive itself on every road in the country. But it could do a lot more than just drive. It carried a highly sophisticated radio and telephone switching system, a system that could perform some clever tricks in order to get comm signals through. Satellite bounces, cellular phone nets, unused sidebands. It could key into practically anything. More importantly, it carried a more powerful transmitter,

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a more sensitive receiver, and better signal processing gear than could be squeezed into Suzanne's remote unit. The van could pick up her home-base signal from as far as ten miles away, and was smart enough to clean up a weak or garbled signal substantially. By letting it handle longer-range communications and relay to Suzanne-Remote locally, Suzanne could in theory travel anywhere in the city and still be in control.

Suzanne could also switch off one or more senses or control channels to put more power behind another. She could, for example, shut down her hearing in one ear to give the vision circuits more bandwidth, or drop back to just one camera eye, or slow the scan speed, if there wasn't enough signal space available for two eyes sending at 30 frames a second. She could cut out manual control of the remote unit, let the onboard systems manage the walking around while she contented herself with doing her own talking. In a worst-case scenario, she could fall back to one vision frame a second, straining to hear from one ear-mike, trusting the remote-unit to maneuver itself while she limited her outgoing control to speech.

She shuddered at the very thought of such a situation. Worse case indeed—for if it got that bad, she would be at the ragged limits of her range, scant feet away from the point where she could drop out of contact with her other self altogether. And she did not want to lose herself.

The relay van pulled into the underground parking below the courthouse. Once underground, it headed straight for the charge-parking slot it had reserved, one equipped with a fiber-optic interface line. It pulled into the slot and extruded its charger line. Once assured of a good power source, it extended its optical cable as well. It sent a radio signal back to Suzanne's house that it had a good hardwire contact and linked back over a fiber-optic line, guaranteeing perfect, maximum power signal reception. But then it went one better, patching into the building's teleoperator radio control system. The system was meant to handle the courthouse's cleaning teleoperators, but it would serve to handle the needs of a remote person just as handily. In effect, the relay van converted the building's entire wiring system into an enormous system of transmitting and receiving antennae.

It took less than a second for the van to establish the whole link-up—and suddenly Suzanne's fading sight and hearing were back all the way. Colors were clearer, edges were sharper, all the muddiness went out of the sound.

It was like clearing the cobwebs from a long-empty room, throwing the windows wide, letting in air and light. There could have been no better tonic for Suzanne's morale at that moment. Flush with renewed confidence, she let the van open the door for her and stepped out into the garage. Next stop, a quick visit with Herbert in his cell, to coach him as best she could on how to sit and act. Then, on to the bail hearing in Judge Koenig's courtroom.

Ted Peng paused just outside the courtroom door, ignoring the people scurrying to and fro on all sides. He hated all the legal skirmishing that came before the real trial. Bail hearing, pre-

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liminary hearing, discovery, jury selection, pretrial motions, pretrial countermotions.

Only after all that deadly dull slogging would they come down to the real *trial*—and it was the trials themselves that Ted lived for. All the rest were to him meaningless rituals, empty shadow-plays and posturings that were for some reason required before the real drama could begin.

Which meant that moments like this were the times he dreaded most. Here, right now, was where all that slogging began. Here, right now, was where he began the long and tedious journey toward his chance at combat.

It didn't help his mood that he was walking in with orders to follow a strategy that seemed custom-made for disaster. Never mind. He squared his shoulder and stepped inside the courtroom.

The place was a madhouse, as he might have expected. That damn news story this morning had pulled them all in here. Not just the reporters—though that would have been bad enough—but all the street loonies you could ask for tossed into the mix as well. Everyone seemed to be arguing with everyone else—over who got what seat, over the merits of the case, over the bum call the umpire made in last night's ball game.

But there was another kind of noise as well. Somewhere below the yammering voices Ted could pick out the whirring of gears and the hum of power machinery. The air in the room was close, jammed with the complicated odor of too many emotional people in an enclosed space. But there was another, underlying tang to the air, made of lubricating oil, of the cooked ozone taste that air gets around overworked electric motors, of unwashed bodies. Ted scanned the crowd and saw more than one flash of metal where skin should have been. Cyborgs. And very definitely low-end types. Lots of them.

Ted's stomach tightened. It was all very good to try and force reform of cyborging, force society to decide on more equitable ways to distribute spare parts to people. But that was all academic theory. This room full of half-mechanical people was real. The sight of people plugged together with machines made him queasy. It was a conscious effort of will not to think of them as monsters, as innately inferior, as bad people.

He shoved his way forward to the prosecution table and sat down. He took a moment and concentrated on calming himself. Whatever trouble he had dealing with the sights and sounds and smells of cyborged people was just too bad. He had a job to do, and could not let such thoughts . . . *disturb* him.

Doing the job would not have been easy even without such disturbances. Entwhistle had seen to that by dictating every detail of the prosecution. And dictating them with utter and perfect ineptitude.

No, Ted decided as he took his seat. Ineptitude was the wrong word. She had done her job of forecasting skillfully, used her skills and tools well. It was just that she had used the *wrong* tools for the job. Artificial intelligence research systems were all very well—but they could only find what they were sent to look for. They could only find what was there in the record. Not what was in the heart.

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There was evidence to support Entwhistle's projections, in the transcript of Suzanne Jantille's trial appearances, and in Jantille's personality profile. Though the profile was derived from a psych systems ArtInt working from third-hand sources, it was more than likely accurate, as far as it went. Ted did not deny the ArtInts were good at what they did. The problem was that Entwhistle was misapplying the results of their work.

The ArtInts were predicting that Jantille would try and get the case thrown out, object to every breath the prosecution took, attempt to torpedo the case before it ever reached trial. The Suzanne Jantille found in the public record, the one who handled *those* cases and *those* incidents in *those* ways, the one who relied on *these* tactics in *these* trials—yes, if this were just an average case for her, that person would play this trial the way Entwhistle's ArtInts predicted.

But that Jantille did not exist anymore, and the present version of that person had never made any public statement or court appearance for the ArtInts to chew on. Jantille's record of public behavior, the only thing available to the ArtInts, predated the accident that changed her life.

Ted Peng knew, Julia Entwhistle *should* have known, that the Suzanne Jantille who emerged from that accident, hideously injured, left with a crippled husband who died shortly thereafter, would have a different viewpoint on life. How could she *not?* After all, what little of life she had seen since then she had seen through a robot body.

Perhaps even more importantly, this was not just a cut and dried case for Jantille. Her husband had been killed—and, according to the state's bizarre contention, her husband that was on trial for the crime.

But there was one other factor, one that was unchanged in Suzanne Jantille. If it *had* changed, she would not have taken the case. That factor was what told Ted that she would never take the easy way out on this case. Just in the act of signing on, Suzanne Jantille had told the world she still had an ego. Every trial lawyer did. The smart ones were aware of that fact, and used the knowledge in their calculations.

This case was a lawmaker. It could ring down the ages, could change the way people lived and acted and thought for decades to come. It asked the most dangerous question of all: *What is a human being?* This case demanded an answer to a whole new side of that ancient question, and Suzanne Jantille was smart enough to see that. That she was taking the case, going into this big a battlefield, could only mean that she *wanted* that fight. That she still had the ego, the gumption, the downright *gall* a good lawyer needed to weigh into something that big and complicated.

And Ted knew she would not have come out of her seclusion to confront issues this big, if her intention was simply to short-circuit the proceeding and go home.

And here he stood, with a strategy geared toward a case his opponent would not be making.

There was a sudden bustling hush of activity from the back of the courtroom. Ted Peng turned, and saw Suzanne Jantille—or at least the robot shell that

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played her part—walking into the courtroom. Another murmur of noise, and Ted turned his head toward the front of the room. With a subdued whirring, the defendant, Herbert the HMU, wheeled his way into court. Ted looked from one of them to the other with real curiosity. These were his opponents. He had never seen either of them in the flesh before—if he could use that expression when they had not so much as a scrap of flesh between them.

For a bizarre moment, Ted Peng was reminded of a church wedding—the groom slipping in by a side door in the front as the bride marches down the aisle, front and center. The marriage of an oversized vacuum cleaner to a plastic doll standing in for a woman. But then he realized how close to the mark that strange thought was. For, after all, it was the contention of the prosecution that Herbert *was* David Bailey. If so, then these two collections of machinery *were* husband and wife.

Herbert brought himself around to the side of the defense table to Ted's left. He locked the pivots in place on his rear leg pair and swung his body around to an upright position, folding his two forward leg pairs against his body. His rear legs bent the way human legs did, and he folded his rear legs back underneath him and knelt, the base of his cylindrical body almost touching the floor, with the head end almost six feet off the ground. Two camera eyes on flexcables spooled out from the top end and pointed forward. No doubt it was the closest approximation of human sitting posture he could manage.

And with that, the stage was set. The first of the pretrial rituals could begin.

All they were waiting on was the widow.

Interlude

Slowly, the fog is lifting off me again. I am learning to see and understand, to control my own mind, to stave off the strange invasions of mechanical thought. Each time, it seems, I survive a little longer. But there are limits I cannot pass, absolute barriers I cannot broach, or even attempt, if I am to survive. Yet I cannot recall what those limits are.

I find myself sitting in a strange room, a room that I know I have never seen before. And yet the pattern *of the place is familiar, the arrangement of tables and chairs, the odd high desk I sit facing, the murmuring crowd of people behind me. I feel I ought to know what* sort *of place this is. There is a ritual performed here, one I ought to understand. But I do not. Do not.*

Set label MEMLIB positive.

Do while label MEMLIB positive.

Procedure: Memory Library Call.

Input: room dimensions, appearance.

Query: room type and use.

Call to MEMLIB negative.

End do.

Dammit, no! That's not the way I think.

Whoever I am. But I cannot remember.

What place is this? The question seems vitally important. I think back/playback the last few minutes, and remember the person next to me ordering me to follow her to this place, and to sit a certain way. But that tells me nothing.

Obeying orders is easy. Too easy.

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Another, artificial mind that I do not control is wired into my body. I am not. It hears the orders, and obeys them; I have no control. Reflex/instinct/high priority programming compel that lower, mechanical self. My memory tells me that this order-following is as automatic, as uncontrollable, as the lungs breathing, or the heart beating.

But I have no lungs. I have no heart. I do not precisely recall what those things are. I do not know why, or how they come to mind. But I know that the part of myself that should have been given over to controlling such autonomic things is instead subsumed by this other *self.*

I have no control. I am merely a passenger, an observer.

I should know what lungs are, what a heart is. But these are mere words now, labels that I can no longer attach to meanings. I should know what this room is, know what label attaches to it, but I do not. Obedience is far too easy, but memory is far too hard. In playback mode, I can remember what happened to me, but not what it meant, what I thought about it or felt about. Or said about it.

Said?

Set label MEMLIB positive.
Do while label MEMLIB positive.
Procedure: Memory Library Call.
Input: define word: "said."
Call to MEMLIB positive.
Input: define verb: "to say."
To speak, to utter words, the action of speech. To express an idea, thought, observation or question verbally.
Call to MEMLIB positive.

Yes! Yes! I remember now, fleetingly, a gossamer thread of memory that I can sense will break soon. Action, talking, saying. I feel a massive, urgent need to communicate—to break out of the shell I am trapped in and contact the outside world, to take over my body and act—overwhelms me.

Input: How do I speak?
Error code. Data Scramble. Data Lock set. Read/write prohibited.
Call to MEMLIB positive.
End do.
Clear memory: Reset.

And the moment is gone, the chain of thought broken, and I can feel my mind being forcibly emptied, know that I must face the long struggle back up to consciousness again. This lower self will smash me down again and again, defend itself, whenever I try to make the effort of acting for myself. It will erase me again. I can feel it, sense it happen. I forget who what where I am—I am lost I am

Set label MEMLIB positive.
Do while label MEMLIB positive.
Procedure: Memory Library call.
Input: who am I?
Call to MEMLIB negative.
End do.

CHAPTER SEVEN
Personal Recognizance

Sam Crandall checked her watch and swore to herself. She was late, as usual. She pushed open the door and made her way into the courtroom, just as Suzanne Jantille and Herbert were settling themselves in. She shoved her way forward into the seats reserved for the press, stage-whispering a string of apologies as she stepped over a whole forest of feet.

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She sat down and congratulated herself on at least beating the judge into court. Probably the old boy was stalling a bit. Sam was willing to bet that Judge Arthur Davis Koenig was not a happy man today.

Sam didn't do much courtroom coverage, but most of it was this sort of very preliminary hearing, the small change of justice in Washington—and that meant much of what she saw in a courtroom involved Judge Koenig.

Koenig almost never judged an actual case. He set bails, granted continuances, threw out weak cases, routed the worthy ones to their appropriate venues.

To Sam, Koenig was obviously a man who had found a stable niche in life, who did not like things to change —and it was cases like this that put his cherished stability at risk. Koenig saw his courtroom as an initial sorting mechanism for the great machinery of Justice, a small but needed cog in the machinery of Law. It was a place to get things in order, where the rough and tumble confusion of life could be sorted into some version of judicial order, a place for tidying up the small details of placement and procedure. His court was decidedly not a place where great issues were to be decided. Not if Judge Koenig could help it.

Except there were days, and there were times, when he *couldn't* help it. And today was one of them. Today was a day when a judge at a bail hearing would be forced to decide questions at the very heart of the law. *What is a person? To whom or what are owed the most basic human rights?* It would be easy to avoid those questions, to throw the whole case out. It would take a bit more character to treat it as a case in law and not a sideshow.

Sam found herself wondering if Koenig was up to the challenge.

The door leading to his chambers popped open and Judge Koenig came bustling out, the clerk rushing through her lines, declaring the court to be in session, abjuring all to rise for the honorable Judge Arthur David Koenig, and for all those with business before the court to draw nigh and give their close attention. Koenig mounted the stairs to his chair behind the bench, a look of obvious annoyance on his face. He sat there, staring straight ahead, as the clerk read the case number and name, the words rattling off her tongue in rapid-fire cadences that seemed to shake all the meaning out of them. The clerk handed the case datapack to Koenig and sat down, and Suzanne leaned forward, waiting for the judge to speak.

But the wait was a long one. Koenig took the pack, plugged it into his terminal, and sat there, moodily glaring down at the flatview set into the surface of his desktop. "The United States of America versus Herbert Hoover the Vacuum Cleaner," he said at last, his voice sharp and petulant. "That's not what it *says* here, Mr. Peng, but that's what this case boils down to, isn't it?"

Sam turned and watched as Ted stood up. Obviously he was a bit thrown by the judge's blatant hostility. Sam glanced at Suzanne Jantille. Suzanne was leaning forward eagerly, as if harboring the tiny hope that things might be breaking her way. "Ah, Your Honor," Peng said, "I can't agree with that. If that were the true nature of the case, the US attorney's office would not be

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wasting your time with it."

"I see. But since you *are* wasting my time with this nonsense, that implies that things are different." His eyes locked on Peng, the judge spoke to Suzanne without looking at her. "Madame Jantille, jump right in here with a motion to throw this case out if you like. You might find me more than willing to accommodate you."

Suzanne rose and faced the judge. "Throw it out on what grounds, Your Honor?"

The judge's head snapped around and his gimlet eyes bored into her. "On what *grounds?* Madame Jantille, there are so many I hardly know which to choose. For starters, because your so-called client can't be tried in a court of law any more than my gavel can."

Suzanne drew herself up to her full height and spoke in a firm voice. "No sir, I disagree. I believe my client has every right to a trial."

There was a buzz and a murmur around the courtroom.

"Madame Jantille, I am having some trouble believing this. I am inviting you to ask that I let your client—or your vaccum cleaner, whatever—to go free. That you would refuse to do so makes me wonder just how competent his—its—counsel is. In fact, I'm very much tempted to throw this case out right now with or without your petition to that effect, because Herbert cannot be vested with legal standing in this or any other court."

"Your Honor, I must protest," Suzanne said. "I strongly believe that the prosecution has mounted this attack on my client for the sole purpose of securing just such a ruling. My client—I would venture to say any person—would choose to risk conviction on groundless charges of murder, rather than to be officially certified not to exist. A convicted murderer is still entitled to the full protection of the law, entitled to file appeals, petition for parole or pardon, fully vested with protection against cruel and unusual punishment or the arbitrary interference of the state. A person cannot be sliced up by government scientists curious to see how he works, or seized and destroyed as alleged contraband mindloading equipment. Even, as it seems highly unlikely, if he can escape whatever the government has in store, my client would be officially certified a nonperson. Any person who chooses to do so could attack him, steal parts off him, harm him without real fear of serious legal sanction.

"If my client is declared a heap of scrap metal, he will have no protection whatsoever against any of these things. Declare him a non-person, and the only real question will be which of these fates he falls prey to first. How could he escape them all when any who attack him, at worst, might be charged with vandalism? Perhaps not even that, since he might well be regarded as abandoned property."

"Abandoned? I was under the impression that he belonged to you, Madame Jantille."

"I deny such ownership as morally reprehensible and legally impossible under the terms of the Thirteenth Amendment," Suzanne said quietly.

Judge Koenig frowned for a moment. "The Thirteenth? I don't quite—"

"The prohibition against slavery, Your Honor," Suzanne said in a half

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whisper. "It doesn't come up much these days. Though if the prosecution has its way, it might start to again."

Suzanne turned and looked straight at Theodore Peng, coolly returning his startled gaze. "Whatever the decision of this court, *I* must regard my client as a person, not an object. I will seek to protect him with all the means at my disposal. But, believing him to be a person, I cannot own him, or even countenance any attempt to set up a legal *charade* of owning him. To do so would not only be immoral, and to my mind illegal, but counterproductive. If I were to acquiesce in even the *slightest* way to any attempt to treat my client as a non-person, I would hopelessly damage my ability to provide him effective legal representation during any subsequent appeal. Therefore I cannot claim him as property. Therefore if he *were* ruled a non-person, the state would be forced to regard him as unclaimed or abandoned property. In the eyes of the law, virtually anyone could then do to him what they liked. Throw this case out, and that is his fate."

"You seem willing to lay out a great deal of your strategy in open court," Judge Koenig said. "Do you deem that wise?"

"Revealing my strategy is in itself part *of* my strategy, Your Honor," Suzanne said. "In any event, Your Honor, the risk of a murder conviction and a prison term is scarcely frightening when up against the prospect of literally being torn apart. Though I might add that I can hardly see how one person can be both murderer and victim in the same crime."

"An excellent point. Could you clarify that slight ambiguity, Mr. Peng?"

Ted Peng turned toward the judge. "Your Honor, the state stands ready to prove that it was the actions of this robot that ultimately caused the death of David Bailey. There can be no doubt that David Bailey is dead, under any legal or medical definition ever derived. His heart has stopped, he has ceased breathing, his brainwave functions are flat. He is legally dead by any measure ever established. No one disputes that. That he died by the actions of this robot we can prove."

Samantha Crandall, watching from the first row of seats, raised an eyebow at *that* assertion. Proof that Herbert did the deed, and not David Bailey himself? There was nothing to suggest it in the evidence that she had seen. And unless Phil was holding back on her, or someone was holding back on him, she had seen everything the US attorney had. Sam glanced over at Suzanne Jantille. Her plastic face revealed no expression, but something about her posture, the way she held herself, told Sam that Suzanne didn't buy it either. But never mind. It was a point to worry about later. She focused on what the judge was saying.

"Mr. Peng, people are killed by defective machines every day of the week. That doesn't make their deaths murders. Murder is a deliberate act, not an industrial accident."

"I agree, Your Honor. But if David Bailey *is* dead, and the robot *did* kill him, we need only prove that this robot *is* legally a person to establish that a murder took place."

"Even though, according to your own contention, the mind inside this ro-

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bot, the part that allegedly makes him human, belongs *to* the murdered man?" Suzanne asked. "Even though, according to your own contention, this robot in effect *is* the murdered man?"

Ted Peng glanced toward Herbert. The massive piece of machinery was just sitting there, watching it all happen, its tentacled eyes swiveling back and forth now and then. Peng licked his dry lips, and at last seemed to come to some sort of decision. "I wasn't planning on it, Your Honor, but I suppose I have to reveal a bit of *my* strategy as well. We have three arguments we intend to advance on that point. One, that the bald facts of the case establish guilt all by themselves. Once you accept for the sake of argument that Herbert is human, a sentient being, then Bailey's death must be murder. A man died as a result of a deliberate attack. Herbert perpetrated that deliberate attack. Dead by deliberate attack is a murder. QED, this death was a murder by all existing legal definitions. The issue of the criminal's identity does not arise, does not change the fact of the crime, and is not contemplated in the statutes concerning themselves with such crimes.

"Two, suicide, self-murder, is widely considered a crime, albeit an unpunishable one. Note I refer to suicide, not *attempted* suicide. There have at times been statutes specifically proscribing suicide. Such a law is indeed on the books in the District of Columbia at this time, passed into law two years ago. Thus, statutes concerning themselves with the possibility of self-murder have viewed the act as a crime."

Sam made a note to herself. That statute citation wagged a red flag in her face. Peng wouldn't dare cite it if it wasn't true, but something about it sounded damned suspicious.

Peng was still talking. "Three, that the very act of transferring a mind from one place, one vessel, to another *must* transform the mind that moves. We will prove that Herbert is a sentient, self-volitional being, beyond any doubt. But we will also produce experts who will demonstrate, far beyond any reasonable doubt, that the act of transferral into a new body, and the act of living *in* such a body—a body with different senses, radically different limbs, different needs, placing the mind in a brain with a new and different basic structure—must change the individual in question so much that she or he *must* be regarded as a new person."

Sam looked again at Suzanne Jantille. *That* one had got her right between the eyes, no doubt about it. This must be the first time she had ever heard of any such idea. What would that be like? Sam wondered. *To be offered up the hope, however slim, however absurd, that your dead husband was not gone, that to hear the person you had loved was not gone forever.* What a seductive hope to dangle before anyone as desperately lonely as Suzanne Jantille must be. *And to be told now, in open court, that it was not so, that her client was a stranger, and not her soulmate.* What a slap in the face it must be.

Judge Koenig seemed less shocked than Suzanne, but not much happier. "This is a case in law, Mr. Peng, not a course in metaphysics."

"I'm very much afraid it's both, Your Honor," Peng said, his voice flat and calm.

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Judge Koenig stared long and hard at Peng, and looked at Suzanne, then back at Peng. "Mr. Peng, Madame Jantille. You are *both* major nuisances and I do not enjoy dealing with you. Ten minute recess so I can think this thing through."

He banged his gavel, stood up, and retreated to his chambers so hurriedly that no one had a chance to rise.

Sam let out a heavy sigh and shook her head. She felt a knot in the pit of her stomach.

This was it, she realized. Not only for Jantille and Peng and Herbert—but for her, for Samantha Crandall. If Judge Koenig came back and threw the case out, *her* story was over too.

An odd, flickering thought flitted through her mind: Without this case, there would be no reason to see Phil Sanders again—and she very much wanted to see him again.

But her first visit had not been altogether pleasant, to put it mildly. She found herself deeply surprised by how much she wanted to go there again. Was there *really* that much of herself that she recognized in Phil? It was a disturbing thought, a whole series of disturbing thoughts.

The door to the judge's chamber popped back open and Judge Koenig bustled his way back up to his seat behind the bench. He settled himself in and looked around, obviously not a happy man. "Very well, let's get this over with," he growled. Peng and Jantille stood up. "Mr. Peng. There is just *barely* enough logic in your words, and just *barely* sufficient *prima facie* evidence, that I cannot throw this monstrosity out on its ear. Not without more basis than I have been offered." He turned to look toward the defense table. "Madame Jantille—you do not wish to offer *any* movement to dismiss? You can offer me *no* grounds whatsoever that I could use to throw this case out?"

"None that would not prejudice the very concept of my client's humanity."

"His humanity. Madame Jantille, your client is a mute, six-foot-tall metal cylinder on wheels."

"Nonetheless, Your Honor. This case must be judged on the facts, not on the physical appearance of the defendant."

The judge looked from one lawyer to the other. "In short, both of you insist on proceeding with this charade, and I can find no grounds on which to prevent it. And, I am reluctantly forced to admit, it may well not be a charade. There may be something to the incredible statements I have heard today.

"Indeed, it seems clear that the issue around which all else revolves is the question of Herbert's humanity. It is the question which must be decided. Should it be established that he *is* a machine, the facts of the criminal case are rendered moot. Only a person can stand trial. If it is established that he is, somehow, human in the eyes of the law, then an eventual trial cannot be bogged down debating that point and will be forced to focus on the facts of the case. And I might add, Mr. Peng, that I see some credence in Madame Jantille's theory that your office is not as utterly convinced of Herbert's humanity as it claims to be. Be forewarned that any attempt by your office to reverse course at a later date and hold that the defendant is *not* human will likely not go down well in front of any judge *I* know.

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If this goes to trial, it will go forward with the explicit stipulation by all parties that Herbert is human."

"Ah, yes sir, Your Honor," Peng said, looking more and more unhappy. Sam shook her head. Entwhistle was not going to be a happy woman.

Koenig nodded dourly at Ted Peng and then went on. "We have an adversarial system of justice in this country, but this time it seems to me that the adversarial system is about to be turned on its head. *Both* advocates are claiming the same central thesis—a thesis that I, the judge, does not find convincing. But I am forced to grant that it is remotely possible that Mr. David Bailey's mind was transposed into Herbert's body.

"Today is Wednesday. I will hold an evidentiary hearing next Monday, at ten in the morning, at which time I expect to see both defense and prosecution ready to present convincing evidence to buttress this claim of Herbert's humanity. If one or both of you do so, we will set a trial date then. If both of you fail to present such evidence, I will throw this case straight out the window, never to be seen again. And if I see any *suggestion* that either side is trying to create a legal fiction here, perhaps to advance some cause outside the issues of this case, I will not be happy. I will issue contempt citations on the spot.

"I note that today's proceeding was supposed to be a bail hearing—but just as only people are liable to legal action, only people are entitled to bail. As no one has yet determined if Herbert is vested with such entitlement, as Herbert seems unlikely to be a danger to the community, and there is certainly no danger of flight, bail is waived—and therefore we can sidestep the problem for the moment. Madame Jantille, Herbert is released on his personal recognizance and to your responsibility. Keep him out of trouble for the next five days. That is all."

Koenig snapped down his gavel and turned toward his clerk. "Next case," he said.

CHAPTER EIGHT

Black and White on a Field of Grey

Suzanne Jantille stepped out of the courtroom, blundering her way through the press of faces and bodies, all of them seeming to clamor for her attention. She felt detached, disconnected, even more so than usual. Surrounded by a throng of bodies, she felt more cut off from the world than she had in a long time.

Herbert was back down on all six legs again, rolling along beside her, an intimidating enough presence to keep most of the crowd at bay. "Stay close, Herbert," she told him, her mind very much on other things. She ploughed her way through the throng and got to the elevator. Mercifully, its doors sprang open the moment she pressed the button. She hurried in and urged Herbert in behind her. His long body effectively blocked the way of anyone else seeking to ride downstairs with them. Good to be alone. At least alone, more or less. She glanced downward at Herbert's silent bulk, stoic and unruffled. Who *was* in there? Her husband? No one at all? A stranger formed up out of the bits and pieces of David's soul? Who, exactly, was she defending?

She found herself edging away from Herbert, getting as far into a corner as she could.

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The door of the elevator slid open, and the two of them stepped out into the parking garage. She led him to her relay van, watched as the larger machine opened its cargo doors to let the smaller machine climb inside. With Herbert safely aboard, she stepped inside and sat down. And found herself staring at the cleaning robot, its gleaming beige cylindrical body hunched over in the corner. Remarkable what a few words in court could do. A few sentences from Peng, and Herbert's presence, taken so long for granted, was now deeply disturbing to her. She stared again at his utterly unhuman body, and wondered with just what or whom she was locked in this van.

The van unplugged itself, cutting its connection to the building's control systems and the fiber-optic link home. Suzanne's senses faded away almost entirely.

This time, for some reason, the loss did not frighten her. Perhaps because she had so much else on her mind. Her vision and hearing drifted away, unnoticed. It was like being wrapped in cotton gauze, a cloud of insulating fuzz interposing itself between her thoughts and the disturbances of the outside world. It served to remind her that she was truly not here. That even if Herbert did go mad here and now, and savagely attacked her, she herself was in reality miles away, back home, operating this robot body of hers by remote control. She smiled to herself. The mental image of being attacked by Herbert the vacuum cleaner was so absurd as to brush away all fears.

At least the court appearance was over. She allowed herself a sigh of relief—and her robot self dutifully echoed the sigh through its speech system. Whatever the reason for it, Suzanne was glad for the feeling of comfort, of safety. It gave her time to think, time to face the surprising knowledge that she had *forgotten* things about being a trial lawyer. Not that her mind was going or that her memory was fading—nothing like that. It was something more subtle, a question of textures and moods and sensations. Like staying inside a sanitized environment for too long, and forgetting the feel of the wind on bare skin, or feeling the warm sun for the first time after a long grey winter of cold.

It was not the knowledge of law, but the emotions, the undercurrents of the courtroom that she had forgotten. She had lost some of her reflexive knowledge of the court's rhythm and cycle.

The hurry-up-and-wait of it she had remembered, the endless delays before anything was accomplished. But the startling focus of human energy, the sensation of being in a whole room full of people with a stake in a matter that was literally life or death, the utter sense of being in the middle of the truest life-or-death drama. She had forgotten how it all felt, lost touch with it as she lost touch with the world. She had let it fade away as her practical skill in dealing with people had withered away.

And the people. The people in that room. Suzanne's remote senses were limited to sight and sound, but somehow, even so, she had seemed to smell their eager attention, taste the muffled anger in the cyborg voices. Those cyborgs, those *people*, wanted something of the law, and wanted it badly—and

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they wanted it of *her*. They were looking toward her, willing that she force the law to accept that cyborgs were fully and truly people. That was the most exciting and frightening part of it. Somehow, suddenly, she was the focus of their needs and desires. They knew a loss in this case was the first step toward society treating them all like machines. And they knew she was the one person in a position to stop it.

But it was more than just the mere pressure of all those eyes on her, all those emotions dependent on her. There was more that she had forgotten. She had forgotten the breathtaking *speed* with which things could happen, the way the bang of a gavel could turn things upside down, instantly melt out reality and recrystallize it in a new form. Her situation was drastically different than it had been a few hours before. Now she was called upon to prove something she did not believe—that Herbert was human. Certainly that was nothing new for a trial lawyer—but just as certainly these circumstances were a little tricky.

Well, she had *wanted* to paint Peng into a corner, and she had done it. Her strategy had worked, perhaps a little too well; she hadn't counted on getting painted into the same corner herself. Damn the judge and his ruling—he had dropped the burden of proof on Peng *and* herself. It was all very well to get up there and make speeches about Herbert being human. But how the hell was she going to *prove* it?

It was a relief to get to her house, to ride the relay van into the garage, watch it dock in its parking slot, watch the garage door close after her. What a pleasure to step out of the van and be *home*.

When she was tired, Suzanne often began to lose a bit of her identity with the remote unit. The comforting illusion that she *was* the remote unit would begin to fade away. She certainly had that feeling now. She no longer was the machine body. When the day began to wear down, her body seemed to remember—and resent—the fact that it was acting out its work through a fancy remote-control system. She no longer was the remote. Instead it was just a machine she was riding—or was it that the machine was riding her? The robot body became less the vessel of her soul and more of an encumbrance, an unwieldy carapace she longed to escape. It was a vehicle she needed to operate, not an extension of her self.

And now, at the end of this long day, it felt like a particularly large and cumbersome vehicle to pilot. The thought of doing the last leg, of getting this mechanical monstrosity upstairs, seemed utterly wearying.

She paused by the side of the van, vacantly watching as Herbert disembarked. After a moment she came back to herself and walked the remote unit inside, Herbert following along behind. Suzanne-Remote paused for a moment. Herbert? Had she ordered the robot to follow her? She didn't recall having done so. Not that she minded him tagging along, but shouldn't he have made his way down to his charge slot in the basement? Never mind, it didn't matter.

She was much more interested in the chance to power down the remote and get out from behind the cameras and

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microphones, to look at the real world through her own eyes—and even to close her own eyes and not look at anything. Of course, she *could* have powered the robot body down at any time once the remote was in the relay van. Her robot body would have made it home. But that was not the sort of chance Suzanne preferred to take. It was perhaps irrational not to trust her body to make it home without her—but Suzanne wasn't much concerned by rationality when it came to taking care of her eyes and ears, her only means of functioning in the outside world.

She made her way to the grand staircase, the one Herbert had trundled down on the day this began, the day they arrested him. But never mind that now. She was a tired mind in a tireless robotic body, in no mood to think. To the top of the landing. Turn right. To the top of the upper stairs. Turn right down the hall. Open the door.

Suzanne Jantille-Remote walked in on herself, and felt once again the disorienting sensation of seeing her flesh-and-blood body from the outside. She noticed that she had left the window open, and there was a breeze blowing in across the powerbed. She thought to close it before checking on her bio-body, but even that effort, even the routine task of checking on her bio-body's well-being, seemed far too much for her fatigued mind. Moving that remote body around was *work,* and she was tired.

It could wait. It could all wait. She walked the remote back into its charging chair and sat it down.

"Attention, helmet," she said. "Disengage remote system, open helmet."

And that was it. Speak the blessed voice commands that unbuttoned the teleoperator helmet and you were *out* of the damned machine, all effort at an end.

The big black helmet split open down its centerline like the carapace of a chrysalis breaking neatly open, revealing Suzanne's pale white face inside. The two halves of the helmet receded into niches in the powerbed and slid out of sight.

Suzanne blinked in surprise.

The room was cold, dark. Well, perhaps only cool and dim, a somewhat cloudy and cool June evening, but the world had seemed bright and warm from the remote's point of view. The remote's vision system had shifted to enhanced night vision mode without her noticing, and she had simply not been aware of the temperature in her bedroom while concentrating on the court appearance and the task of working the remote body. She had only a limited ability to sense temperatures below the neck anyway, and she had simply managed to disregard whatever sensations she did get. The shock of transition made the change seem more dramatic. Now Suzanne realized that her bio-body had been cold for a long time. Why hadn't she set the power bed to control the room temperature? How had she not noticed the cold? How could she have become that detached from her flesh and blood self, even as she was feeling detached from the remote? If she lost track of *both* bodies, where *was* she?

A shiver coursed through her body, partly from the cold, and partly from her unsettling thoughts.

She ought to do something about the cold. That window certainly ought to be

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closed. And she could do with an extra blanket. But even ordering the room to close the window, even rousing her remote to get a blanket, would require effort, and she was exhausted. She sighed and closed her eyes. It was too much effort, too much to do . . .

Her mind exhausted, Suzanne drifted off to sleep before she could care for herself. She slept on, barely mindful of her body shivering in the cold night.

Sam Crandall followed Ted Peng into his office and looked around with more than a little apprehension. She had never felt at ease in a government office, especially a government lawyer's office. She always harbored the nagging fear that they would catch her this time. Who "they" were, and what they would catch her at, she didn't quite know, but that didn't make her feel any more at ease.

On the bright side, Entwhistle wasn't willing to see her, at least not yet. That suited Sam fine. Despite all Gunther's tactics and theories, Sam was not at all thrilled about interviewing a powerful woman she had publicly embarrassed.

On the other hand, Ted Peng, a somewhat less intimidating target for an interview, had been absolutely eager to talk. Judging by his behavior as he welcomed her and steered her into a seat, he was ready to talk at a bit more length than she had bargained for.

But eager or cautious, the result was going to be the same. Even as she settled herself into her seat and watch him sit down in his, she knew what she was going to get. The routine stuff that she had heard from defense and prosecution attorneys a hundred times before. She pulled her notetaker from her purse, and set it up to transcribe and record.

Just for a moment, she looked at the little gadget and envisioned what those notes would be like, envisioned what the story she would write from them would be. *The US attorney's office today expressed confidence that the David Bailey case, now in preliminary hearings, would come to trial, and feels certain of victory. The government's trial lawyer, Theodore Peng, said the government's evidence was solid. Incontrovertible, blah, blah, blah.*

In short, the same old hill of beans. She could have written it already, and not changed a comma after the interview. Prosecutors always had to say that sort of thing before a trial. Peng could not speak in anything more than generalities, because he had to protect his case, avoid revealing anything to Sam that he would not want Suzanne Jantille to know.

Maybe that was all Peng could give her at this point without blowing the case, but it wasn't enough. Sam looked again at the notetaker. The hell with it. She put it away and looked toward her host.

"Let's not do it that way," she said.

Ted Peng looked at her in surprise. "What do you mean?"

"You like your case, right? You've got all the evidence you need, and you feel sure you'll go to trial and win. I could use just those words in the story and you'd be happy, right?"

"Ah, well, yeah. Right."

"OK, so I can put that in the paper tomorrow without both of us wasting our time. I don't feel like asking questions you can't answer, and you don't

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feel like hearing them. Right again?''

Peng looked at her suspiciously. ''I suppose.''

''So let's just pretend we've had the cut and dried interview, and I'll put the standard boilerplate in the paper anyway. Since you've got to be recording this conversation anyway, you're still protected against my misquoting you.''

Ted Peng began to crack a smile. ''OK once again. But if we don't have the standard interview, what do we have instead?''

''A conversation. An old-fashioned chat, completely off the record.''

''A conversation about what?''

''Anything you want. Whatever's on your mind. How the Senators are doing this year. Your last vacation. The case. Your cat.''

''I have a dog, not a cat. What's the point of this?''

''I learn about you. I get to know you, you get to know me. Odds are this case is going to be around here for a while. I'll be writing about you, talking with you, all that time, and we'll be able to go past the standard quote nonsense to what's really going on. If I get some feel for who and what you are today, I can do all that better tomorrow.''

Ted looked at her for a long moment. ''Off the record? Anything that's on my mind? I'm a government lawyer. We don't talk in broad terms.''

''Give it a try. Off the record. Your view of the world, in broad strokes and general terms, as a person, not as a government employee. For example, what are you thinking about right now?''

He grinned wickedly. ''Ya got me. I'm thinking about the case, and what's wrong with handling these things the way we do.''

''What things?''

''Social issues, questions of rights and responsibilities. That broad and general enough for you?''

''Plenty. That's the kind of stuff that will do me some good. But what's wrong with how we do things?''

Theodore Peng leaned back in his government-issue chair and put his feet up on his government-issue desk to regard the government-issue ceiling with a far-away look. ''We've got this great tool, the judicial system, and we're using it for the wrong things. And when we do that, the system doesn't work very well. To put it in another way, when the judicial system is misapplied, it is very good at doing something most people don't want it to do.''

''And what's that?''

''It can take any two opinions, any two ideas, any two people, and turn them into adversaries where one has to win and the other lose.

''People talk about a spectrum of opinion, and the image that puts in *my* mind is a strip of ground, with one person standing on one end, and another standing on the other. Both or either of them can walk toward the center, meet somewhere in the middle ground between them.

''But there *is* no middle ground in a court case. It gets cut away, and those two people are suddenly making their stands on bits of ground that have no connection with each other. Try a case in a court of law, and, usually, there is no place for compromise. One person must win, the other must lose. The judge or the jury has to find *for* one

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party and *against* the other. The judge can't find for both, or neither, or rule that both sides have their points. One side is right, the other is wrong.

"Now, in a criminal case, that's usually a pretty good way to get at the truth. The defendant says he's innocent, the prosecutor says he's guilty. One of them is right, one of them is wrong. But even there you get grey areas. Extenuating circumstances, states of mind, rules of evidence, and cross examination can fuzz the line, cloud the issue, render things uncertain. I have tried a hundred cases when I've spent the whole trial utterly believing that the defendant was guilty. Then the jury will present its verdict, and it will be over. And I'm not a prosecutor anymore. I'm a guy who was in a room full of people who've been telling a jury contradictory things. And suddenly I won't know *what* to believe.

"If it comes down to a fine point of law in a complex case, no one, maybe not even the defendant, will ever truly know for certain if the guy actually broke the law. But the law had no room in it for 'maybe,' for 'we're not sure,' for saying 'it's too close to call.' Yes, there are such things as hung juries and mistrials, but those are admissions of failure, not resolutions.

"Judges and juries must decide yes or no, sometimes on very scanty evidence, sometimes with a huge case turning on a trivial point, because *something* must tip the balances away from dead center, move the case in one direction or the other. The defendant's tone of voice. The contradiction of a minor witness by another minor witness. The judge's ruling on an utterly peripheral point.

"Still, that way of doing things isn't so bad in a criminal case. The defendant did or did not do it, the prosecutor can or cannot prove the case. But how about in a criminal lawsuit? In a civil suit? How about a divorce? It's patently absurd that a marriage can come down to who wins and who loses, that the problem of two people who aren't in love any more can mutate into seeing who comes out ahead in front of a jury.

"No matter how grey or murky the situation, the jury is *forced* to call that greyness either black or white. I know there are some exceptions, and I can rattle them off as fast as you can. But the law says you *can't* be a little bit guilty, or slightly innocent, anymore than you can be slightly pregnant. It's all black-white, good-bad, right-wrong, win-lose, with no middle ground. That makes no real-world sense at all. In real life, there *is* middle ground. Most times, both sides *are* slightly innocent and somewhat guilty. It is, almost always, a little bit your fault and a little bit mine."

Sam looked carefully at Peng. "So what are you trying to tell me, strictly off the record, about our friend Herbert?"

Ted looked at her, his expression suddenly more serious. "That we are up against a field of grey that is not black or white, and yet we have no choice but to call it one or the other. That we have a mechanism—the court of law—designed for other purposes that is dreadfully unsuited to the purpose of deciding whether Herbert is human. But that we must use that mechanism because there *is* one other grey area that we *must* treat as black and white."

"Which is what?"

"The question of what a human is. Ask what Herbert is and the *rational*

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answer is that he is somewhere between human and machine. That is obvious, self-evident, and certainly true. And we, society, cannot accept that answer."

"Why not?" Sam asked.

Ted pulled his feet off the desk and leaned forward, his eyes intense on her. "Because that puts us into the business of assigning *degrees* of humanity. If we face the truth and say that Herbert is, say, half human, then what is next? Do we declare him vested with *half* the rights of citizenship? And how do we rate someone else who is partially mechanical? How mechanical do you have to be, how many artificial parts are needed, before you are regarded as only partially human in the eyes of the law? And what fraction of legal protection do you deserve?" Peng paused for a moment, and looked at Sam with a strange look in his eyes. "Did you know that Judge Koenig was the judge without a heart?"

Sam blinked, startled by the sudden change of subject. "Huh? Well, I'm not surprised, given the way I've seen him handle cases."

"No, I mean he literally does not have a heart. It's a bit of a joke in the US attorney's office. His original heart went bad, had to be removed years ago. It was replaced with an artificial unit."

"I never knew that," Sam said.

"You still don't. We're still off the record," Ted warned her. "No one is supposed to know about it. Having artificial parts is not the sort of thing you talk about in polite society. Cyborgs are bums, panhandlers, hot dog vendors. They aren't judges or lawyers or executives."

Ted stood up and looked out his window. For a moment, his posture reminded Sam irresistibly of Phillipe Sanders staring out his window at the close of that strange visit, just before she went home, looking out over the same landscape of problems from an utterly different viewpoint.

"Except some cyborgs *are* judges and lawyers and executives, of course," Ted went on. "The vast majority of cyborgs are well-off people. After all, you have to be rich to afford the operations. The trick is to be rich enough to *stay* wealthy afterward. Many down-at-the-heels street cyborgs used to be fairly well off—but buying the new parts bankrupted them. The ones who stay rich don't like the fact that many of their own kind are suddenly impoverished social outcasts.

"That's probably a big part of the reason rich cyborgs would never dare dream of *calling* themselves cyborgs. They find it a disturbing idea that any such thing could happen to them. So they block out all thoughts of cyborgs. They refuse to know what they really are—and the rest of us go along, let them keep up the illusion. They regard themselves as well-to-do people and keep quiet about the little operations they've had. Mentioning such things would be in bad taste."

Sam thought for a moment. "So if you rule that a mechanical person is not human, suddenly the upper class is filled with second-class citizens."

"Bingo."

"So why aren't they getting involved in this case as friends of the court, or something?"

"I don't think many of them have figured it all out yet. Or else they haven't come up with a way of talking

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about it without bringing up the unpleasant subject of their own spare parts."

Sam nodded thoughtfully. "But there's another way to look at it, you know. I've been asking myself: How do you define a robot? And the best that I've come up with is that a robot, a true robot, not an HTM or remote, but a machine that can act for itself, can be defined as a machine that acts like a human, or better still, one that *thinks* like a human. A machine that can solve problems, respond to new situations on its own, and so forth. The more sophisticated and humanlike its thought processes, the better a robot it is judged to be."

"OK, so what?" Ted asked, turning around to lean against the window sill.

Sam shook her head and stared at nothing. "So when do we get to the point when a robot thinks *enough* like one of us that we must *count* it as one of us?" She looked up at Ted. "Or, to sandbag you with an off-the-record question I'd *love* to ask with all my recorders going: What do *you* think? You, Ted Peng, guy who owns a dog. Is Herbert human? And if he isn't, *could* he be? Can a mechanical device be *one of us?*"

Ted sat back down in his chair and sighed. "What do I think?" Twilight was falling, and ruddy light washed across his face. "It beats the hell out of me, lady. It beats the hell out of everyone. Including the judge who has to say otherwise."

Interlude

Victory, at least of a sort. I still cannot control my body. If I understand the mechanical indicators correctly, I never will be able to do so. Not directly. But if I cannot command my body, I can guide it. I am learning the ways my mind is interconnected to its new home, and finding subtle ways to influence those connections. The system is designed to fall back into certain behaviors if no orders are forthcoming for a certain time, resetting its defaults. I can prevent such resets, thus causing previous orders to remain in force. If I wait for an order that matches my wishes and then set up a default-block, I can force this body to keep following the existing orders until they are directly countermanded by a new and specific order. It is a limited control, but it is there.

So I wait for such an order, ready to lock on to it when it comes. At last it comes from the woman who is somehow taking care of me, in ways I do not understand. I feel I should know her, and should know what the conflict is that entangles both her and myself. But I do not know. I feel I want to stay with her, be with her, for reasons I do not understand.

She is the source of nearly all my orders. When she gives me an order to follow her, I know that is a thing I want to do, and I set my blocks in place. We arrive home (though home is a concept I do not fully understand) and the default programming system is activated. The machine part of me is programmed to return to its charging booth when at home, with no orders given.

But my trick succeeds, and my blocks defeat the default sequence.

And I can stay with her.

This makes me happy. ■

TO BE CONTINUED . . .

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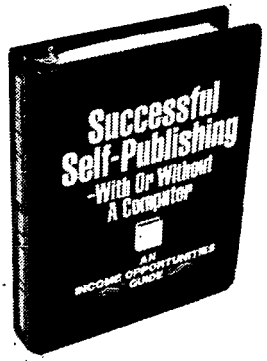

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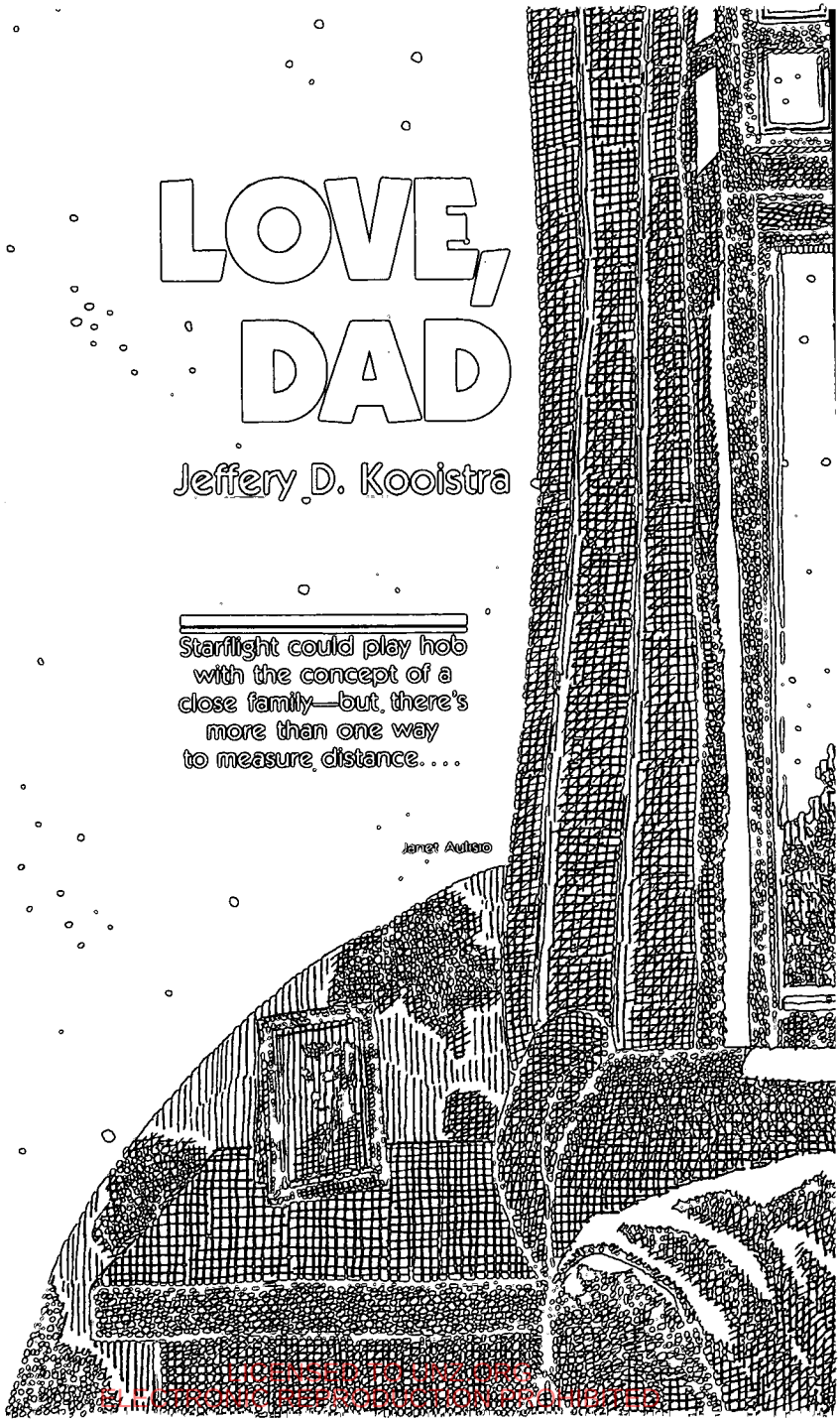
LOVE, DAD

Jeffery D. Kooistra

Starflight could play hob with the concept of a close family—but there's more than one way to measure distance. . . .



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Transmitted: June, 2093

Dear Sandy,

Thank God for anti-matter! Without it, this trip would take a hundred years rather than just twenty. Still, that's an awful long time to be away. But for me to be on the first starship is worth it. I am exactly where I want to be, and I often think about those times when Dad and I would sit out in the yard and talk about the stars and how someday we would go there. To see up close an entirely different solar system . . . Man, oh man!

I wish you would have come.

But now I understand (how could I not, after all the bitter arguments we had) that you and I are just too different to understand each other's thinking. For me, traveling to the stars has been a lifelong dream, and when the chance came, I had to take it, or be unhappy for the rest of my life. To you, a star journey would be nothing more than living in a cage (albeit, a big one) for twenty years, with always the same faces and the same rooms and never any new places to visit. My fulfilled dream would be your fulfilled nightmare.

I guess that the divorce was a good idea. I could hardly expect you to wait twenty years for my return. It is best that you and our precious little Dorothy live without any obligations to me. But never forget that I love you now, and will love you both forever.

I've almost reached my three-hundred word limit. Tomorrow, the *Columbus* goes into boost and I'll be on my way to Alpha Centauri. I hope your love will go with me. Kiss Dorothy for me and tell her that Daddy loves her.

All my love honey,
Ken

Transmitted: June, 2093

Dear Ken,

I waited days before trying to write this because I wasn't sure of what to say, or of how to say anything in just three hundred words. I still don't know what to say because my feelings are so mixed up. What you said in your letter makes sense, but I still feel so hurt, so betrayed. And I think that I may have made the wrong decision.

Would I have been able to live with a man who had been denied his dream? Would I have been able to stay sane on a starship for twenty years? Either way, I'm beginning to think we should have taken that risk. But we're both so stubborn. Which one would have given in?

But now on a happy topic: Dorothy is trying to walk! She crawls over to the couch, pulls herself up to her feet, and by holding on even manages to take a few steps before she falls on her little fanny. She misses you. She was only four months when you left for preflight training. She can't talk, but mama can tell when her little girl thinks something is wrong. Sometimes I see her staring at that big picture of you over the TV, and sometimes she cries for no apparent reason and I can't get her to stop. But usually she is happy. She loves to stare at the TV, and the doctor says she's developing just right, maybe even faster than normal.

I did give Dorothy a kiss for you, and I'm sure she wants me to send one back. I do still love you. I'm sure that, in some ways, I always will. Please write back as soon as they let you send your next Personal.

All my love, too, hon,
Sandy

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Transmitted: June, 2094

Dear Sandy,

Now that we're out of boost I can send a Personal again. I guess it's a bit late to have second thoughts. We made our decision, and, logically, it was the best one. But I admit that many times I wake up in the middle of the night and my heart doesn't think so.

Since you can get the ship news off the TV, I'll leave that stuff out. But you might wonder about those people you see on TV. Capt. Graham is as competent as he looks. First Mate Denise Masterson is a real bitch. Doctor Stewart can't stand her, and he and the other scientists keep talking about "doing something" about her. I think this political stuff is all rather silly.

Most of the other people that I spend time with are wonderful. We've all been dreamers, and we're all having our dreams fulfilled. I've made some friends among them. Richard in biology shares my sense of humor. Ted and Judy are a husband/wife physicist/doctor team. They keep trying to fix me up with the few single lady Ph.D.s aboard, but I'm not interested.

Really, I'll never find anyone to compare to you, Sandy. I miss your soft hair, how you used to whisper my name. You know.

And I miss Dorothy. I wish I could see how big she is now. By now she must be speaking. Did you teach her "Daddy"? Tell me about my little girl.

The first year went well, sweetheart, but I sorely miss you. I don't want to get maudlin, but sometimes I think the dream I really wanted I already had, but left it behind on Earth. Keep me in your thoughts, my love. You are never far away from mine.

Missing and loving you,
Ken

Transmitted: September, 2094

So you wake in the middle of the night, too. If I start talking about that now I'll just cry, so I'll tell you about Dorothy instead.

She is the most precious darling of a daughter you could hope for, Ken! She's into everything, but she's such a sweetie I just can't get mad at her. Of course I taught her how to say "Daddy"! She knows that Daddy is that man in the picture, and she says she remembers you holding her. (Well, she doesn't quite say that, but I know she remembers you.)

It's funny, but I can see a lot of your personality in her already. She plays with blocks, but she actually makes little buildings, and she gets testy when I knock them down and pick up the blocks. The doctor says she's very, very bright. When she's a little older I'll have her tested, but she'll probably be another scientist, just like her daddy. I know it.

Your mom and dad are fine. They come over to see Dorothy at least once a week and love babysitting her. Your mom asked me how I would take it when you came home and were only a few years older. I tried to tell her that you were only going at about half light-speed and you'd only age a little slower, but then I saw your dad roll his eyes so I knew he'd already tried to explain it to her, but had given up.

As I write, Dorothy is playing at my feet with her Pooh bear and her bunny. She talks to them. I think she thinks

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they're people. She's looking at me. She just said "Me Daddy."

jfkdir93 94jd,xls. That was from her. It means I love you.

So do I,
Sandy

Transmitted: April, 2095

Dear Sandy,

jfkdir93 94jd,xls to her, too. I always get restless waiting for your letters to come. I crave words about my, our, daughter. I sometimes wonder if I don't miss her even more than I miss you, and I don't even know Dorothy, not really. Why did I have to run off to the stars when I could have experienced the wonder and beauty of watching my child grow up? Please, more news when you can.

Shipboard routine is just that, routine, and most of the group is getting a bit stir crazy. Doctor Stewart started a newspaper, a real one, on paper, and Ted and Judy help him write it. The first few issues were boring, but now some of them are downright slanderous of Mate Masterson, and since we all hate her, the paper is now fun to read. Actually, we don't all hate her. Richard actually slept with her twice. He told me she gives orders in the sack, too. Doc Stewart overheard a bit of that and wrote a hysterical opinion piece about sex in space. It was a takeoff of Swift's "A Modest Proposal." I'll keep a copy of it for you.

As for sex in space, I'm doing without. I don't want anyone else but you, Sandy. I don't even think I could perform with anyone else, even if I wanted to. I now know my vows were to you, for better or for worse, and I had no right to run out on you and Dorothy. I'm sorry. I now know you always were, and always will be, the only one for me. I'm not so stupid to think I can ask you to wait for me, but for what it's worth, I'll wait for you.

Always loving you,
Ken

Transmitted: April, 2096

Dear Ken,

Of course I'll wait for you! There isn't anyone else for me. I always knew that. It bothered me terribly that you never seemed to understand. I love you as much as any person can love another. And I haven't "performed" with anyone else, either. You're mine, lover, and now that you've admitted it, you'd better not forget!

And our little girl is growing up so quickly! She's only three, but the doctor says she talks like a six-year-old. She's also taught herself how to read, and when we go to the store it's all I can do to drag her away from the book section.

She has one big picture book called *A First Book of Spaceships* that she takes to bed along with her bear. I showed her the picture of the *Columbus* in the book and she always shows that picture to her friends and tells them that's where her daddy is.

I'm going to start her in school next fall. She'll still only be three when she starts, but it would be ridiculous to hold her back.

And now she wants to write to you.

Dear Daddy,

How are you? I am fine. I want to go on a spaceship too just like you and be with you. Mommy said i can but i got

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to be big first. I love you Daddy.

Dorothy

That was our little girl! She has hair color like yours when you were little—white as beach sand. We already know where she got her brains from, so let's hope that she gets her beauty from me. I only have a few more words so I just want to say I love You I love You I love You.

I love you,
Sandy

Transmitted: April, 2100

My dearest darling Sandy,

You don't know how you've made the stars shine brighter and the (disgusting) ship food taste better, and the flat air smell sweeter since you told me you'd wait! I wish I were good at writing love letters, but you know me—my hands only connect to my heart through the brain.

I have so many plans for us when I get back. We'll have plenty of money with my accumulated back pay, and we'll buy a place in the mountains, just like you always wanted. And I promise, honey, once I'm back my wanderlust will be gone, and I'll take a nice, comfortable position at the University and the only traveling I'll do will be with you and Dorothy. Of course, she'll be in her twenties then, and she might not want to go with us. Drat, I'm on the greatest human adventure of all time, and all I can think about is getting home to see you and our daughter.

If I've figured things out right, she should be ten by the time you get this. So: Dorothy, daddy loves you. I want you to listen to your mom and do what she says, and I want you to work hard in school so you can be a scientist just like your daddy, if you still want to. I think of you often, and when I get to Alpha Centauri, I'll name something, a moon or asteroid, after you.

Love,
Your dad

Aw, hon, I can't wait to see you again. Sometimes I take your picture with me to the observing dome, and watch the stars with you. In the lounge the piano player wonders why I always request "Luna, Lovers, and I." But you and I will always know.

I love you,
Ken

Transmitted: April, 2103

Dear Daddy,

Grandma says they told you when Mom died. The accident was very bad. I was in the hospital for a month before they let me back out. Grandma and Grandpa are taking good care of me. Grandpa tells me stories about when you were a little boy and how you and him used to look at the stars from the backyard and how you always said you wanted to go to the stars, and now you are. I want to go too, so I am studying very hard in school to get good enough grades. I am in eighth grade now. I was moved ahead because the stuff we were learning in my grade I already knew and was bored by it.

My best friend is Tracy. She is only in sixth grade, but she's my same age so we do things together. She's a lot of fun. The other girls in my grade are only interested in boys and are not very smart. They don't care about school, only about the boys. The boys are dumb, too, and I'm smarter than all of

Love, Dad

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them. But Kevin though, is nice. He likes dinosaurs mostly, but he also likes space and astronomy and he likes it when I tell him that my dad is on the *Columbus* and what you're doing.

I think that's all I can say now because I don't have enough room to say any more. I love you Daddy. Don't forget to name a planet after me.

Love,
Dorothy

P.S. I'm eleven, not ten.

Transmitted: September, 2106

Dear Dorothy,

I wish I could tell you how sorry I am that I wasn't with your mother and you all those years you were growing up. I loved your mother very much. I hope Grandma has let you read some of the letters your mother and I exchanged while I've been on this ship. Although we were divorced, in our hearts we remarried.

But I get choked up thinking about her.

By the time you get this you will have seen all the stuff in the news about the expedition. I have all kinds of personal files for you to see when I get back. I hope the news showed your planet to you! We found a small planet orbiting close to Alpha Centauri and I won the ship pool and so I was able to name it after you. So now all of the other planets have a morning star named Dorothy.

Your dad managed to do some good science out here, but it wasn't worth leaving you behind. I was a fool to go. Still, it's a little too late to cry over that spilt milk now, and I hope you can forgive me. I love you, Dorothy, my little girl.

Keep studying hard! Although I should have stayed with your mom, visiting the stars is still a great adventure. By now you should have a different view of boys than you did last time. Find one who shares your dream for the stars, and marry him. Exploring new worlds with someone you love is the best of all possible dreams, and it's worth any sacrifices to hard work you may have to make now.

I hope you don't resent getting advice from a far distant dad, but it's my way of helping you now.

Love,
Dad

Transmitted: February, 2110

Dear Father,

Though your last missive arrived last month, I have been too involved in my studies to reply until this moment. It feels strange to me in that my previous letter to you was written when I was only eleven, yet now I am fully eighteen. You missed my adolescence entirely. Sometimes I wish I had missed it, too. Perhaps you also dealt with difficulties as the brightest individual in your class, and yet the youngest. Grandfather has told me many stories of your youth. Yet you never had to deal with the problem of being the youngest, brightest, and also the only woman in a still heavily male dominated field.

But I do not wish to spend this whole letter complaining.

I have been at the University for ten quarters now, and I am pursuing a degree in astrophysics, just as you did. Though we really don't know each other, I hope you will be proud of me for following in your footsteps. I hope soon to also follow in your later foot-

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steps and travel to the stars myself.

As for finding a man to marry, now that is an eventuality that is not likely to develop. The only men in my life are Grandfather and you. Grandfather and Grandmother have been very good to me, and have treated me as if I were their own daughter. Grandfather and I still spend many star-filled evenings in the backyard, looking at the sky and wondering about you. Grandmother still thinks you will only be a few years older than me when you return. Like Grandfather, I've given up trying to explain the true situation to her.

Oh, there is one other man. My friend Kevin from junior high is at the University now, too.

Your daughter,
Dorothy

Transmitted: April, 2111

Dear Dorothy,

In a little over two years I'll be home. It's hard for me to believe that after all this time, our reunion is finally getting close. Your last letter made me sad in that I wish I could have been with you to help you through the trials of being a gifted adolescent. My own teen years were nothing to look back upon fondly. Your mother was only the second woman I ever dated, and that wasn't until I blossomed in my twenties. She was such a special woman—I had no idea just how special until I actually had a chance to compare her to other women I've known professionally or as friends.

After your mother died there were some women on the ship who sought my attention, and at times they got it. But they could never replace your mom, and I think they realized that, and so it doesn't look like I'll be introducing you to a stepmother when the *Columbus* gets back.

If you've read some of the old messages I sent your mom, you might be interested to know that Doctor Stewart and Denise Masterson got married a few months ago. They're still after each other's throats, but in a different way now. Richard also got married, to Judy Phipps after she and Ted were divorced. Long journeys do things to people, particularly when they're all stuck together like we've been all these years. The most important data from this trip may be psychological and sociological, rather than scientific (is my prejudice against the soft sciences showing?).

Keep your chin up, my darling daughter. You have a wonderful life and career ahead of you, and your daddy will be home soon to take care of his little girl.

All my love kiddo,
Dad

Transmitted: June, 2112

Dear Dad,

I'm so excited! In two days I get to leave for my summer internship on—are you ready? THE *MAGELLAN*. Only fifty people on the entire planet qualified for this internship, and best of all, Kevin qualified, too! We're supposed to be taught all about ship systems and things, but most of us believe that the real reason behind offering new post grads this opportunity is to get cheap, skilled labor for setting up the laboratories on board. But I don't care! Rumor also has it that maybe half of us interns will actually get to go to Tau Ceti when the *Magellan* sets out in two

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years. I'd love to be one of them, but even if I'm not, there will be others.

To catch you up briefly, I finished my undergraduate degree last month, and I graduated at the top of my class. Feel free to brag about your brilliant daughter to your friends, hah, hah. Also, Kevin graduated at the top of his class, too, in exobiology. Last time I said Kevin had just arrived at the University, and though I never would have believed it, we've been inseparable ever since. I'm in love, Dad. Everything looks so lovely now! Kevin and I haven't set a date yet, but I want you to give me away, so I guarantee we'll wait until you get back.

Grandma and Grandpa are planning a big party to welcome you home. Since that's still a year away I think maybe they're jumping the gun on the planning. Since I don't like to be surprised by things like that, I'm assuming you don't either, Dad. So just smile and wave and act surprised.

I love you, Dad. I'm so glad you're almost home. Kevin says hello.

Your loving daughter,
Dorothy

Transmitted: September, 2112

Dear Dorothy,

I suppose by now you have set a date, so CONGRATULATIONS! I'm so happy that you found someone who shares your dream. I just hope that both of you will be able to go together on the *Magellan*. But honey, if it turns out that one of you is accepted, and the other isn't, don't make the mistake that your mother and I did. Although we at first parted bitterly, and then realized our foolishness, my big fear for you is that you or Kevin might grant the other a divorce out of the mistaken idea that it's somehow noble to not stand in the way of the other's dream. Remember that fulfilling the dream doesn't involve dealing with the nightmare of leaving the one you love behind.

I know I'm a distant father, but if you ever listen to any of my advice, listen to this: If you can't go together, don't go at all.

Enough of the heavy stuff.

Now that we're getting close, Earth is transmitting historical updates for us about what's happened while we were gone. I found the scientific history the most fascinating. I see that the *Magellan* will make most of its journey at over .8 cee. Incredible! When the *Columbus* left they told us .5 cee was already pushing the limit. If we'd had the same drive I would have been home years ago!

The political news is curious, too. What do you think about this Solar System First group? Are they really against starships altogether, or is the encapsulated stuff I'm getting slanted against them? And are they really gaining political influence? Most importantly, can they really stop the starship program?

Anyway, you know I look forward to finally seeing you, my dear daughter. I am so proud of you!

Love,
Dad

Transmitted: December, 2112

Dear Dad,

Thank you for the congratulations! You were right about that. Kevin and I have set the date for June 10, so you'll have two whole weeks to get ready (and one week to recover from that big party

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Grandma and Grandpa are throwing).

As for the SSF Party, they are as big a deal as you seem to have been told. In a way I should thank them, because they're responsible for my job. I didn't go to grad school in the fall like I'd planned. Both Kevin and I impressed our mentors during the internship, and they asked us to stay on for six more months. The SSF people are really trying to get the starship program eliminated, so the director moved up the timetable for getting the *Magellan* and the *Drake* finished. He thinks if he's already got completed starships waiting to go when the budget renewal comes up that the council will be more inclined to at least let the finished ones go, rather than waste the money that's already been spent.

Dad, I can't believe the question is even raised! Of course we should go to the stars! They belong to us, all the creatures intelligent enough to design ways to get to them!

Dad, I'm so happy that you're almost home. Although we don't really know each other, you've been in my thoughts always since I was little, and I guess I never really felt like I had no father. I always knew you were coming back, and now that the time is close I, well, I start crying every time I think about it.

Kevin wants to say something: Sir, you have a beautiful, wonderful daughter. I promise to take good care of her.

Kevin.

And he will, too!

Loving you and waiting,

Dorothy

Transmitted: February, 2113

Dear Dorothy,

Almost home! I'm getting so close I can almost taste it. Too bad you're not living in the southern hemisphere—you could probably see the ship's drive flame with a small scope. Come to think of it, you certainly could see it from the *Magellan* with their scopes. Have you looked?

Tell Kevin that I know he'll take care of you, simply because you're my girl and I know that you must have good judgment in men. Besides, how could anyone mistreat anyone as perfect as my daughter?

Seriously, honey, don't worry about the political situation. They will fund the starship program. Too much has already been invested to pull out now, and I'm sure that next year you'll be on the *Magellan*, or at least on the *Drake* the year after.

All of us on board have been talking about what we'll do when we get back. I promised your mother long ago that I'd take a nice, quiet job at the University, and now I'm actually looking forward to it. One of your professors, Doctor Haan, sent me an official invitation to join his physics department. I've gotten other offers, too, and I'm going to keep Haan guessing, but I fully intend to accept his offer.

I can't wait to see you! Now that the time is so close, the weeks seem to drag by. Still, there's plenty for me to do as I help get all the collected specimens and special equipment packed away for removal to Earth. I do promise to look surprised at the party, at least when I can manage to take my eyes off you. I'm ecstatic that I'll be able to give you away at your wedding. Your mother would have wanted that, too. I'll be

Love, Dad

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home soon.

Love,
Dad

Transmitted: March, 2113

Dear Dad,

I'm so mad! The SSFers actually got the *Drake* mission canceled! So far the *Magellan* is still supposed to go, but who knows what will happen now? I guess the *Drake* is going to be completed anyway, late of course, and then used for additional Solar System studies, but what a waste. I guess I should at least be thankful that it will be a fully capable starship, and if the political people get their heads screwed on straight she may still go to the stars.

As for the *Magellan*, there's an incredible scramble going on amongst the scientific folk for any and all openings for the Tau Ceti mission. I doubt if Kevin and I will get to go. With only one ship going to the stars now in the foreseeable future, I don't see how two post grads stand a chance of making the cut. Damn.

Oh, Dad! At least you'll be home soon, and Kevin and I will be married, and I'll finally have a family of my own again. I guess it won't be so bad finishing my doctoral work while I wait for the next starship. Maybe I'll even have my own dad as one of my professors.

I was home to see Grandma and Grandpa last week. Grandma is so excited! I think you're actually going to get your own parade, Dad. I thought I'd better warn you now. Grandpa doesn't show it like Grandma does, but I know he's so proud of you! It isn't every man who has a son who went to the stars. And it isn't every girl who has a father who did it either.

And yes, I have watched the *Columbus* return through the telescope. I wouldn't have missed it for the world.

I love you,
Dorothy

Transmitted: April, 2113

Dear Dorothy,

This is it! The last letter! Next time we'll be together! We're all so eager to get back that we've had everything that needed to be packed up all set to go for a week now. And we won't hit Luna until next month!

I sent a message to Doctor Haan and accepted his offer, but at a significantly higher salary than he mentioned the first time. But I won't be starting at the University until the fall of 2114, so I'll have all kinds of time to spend with you that first year I'm back.

Dorothy, there's so much I want to show you, so much that I want to tell you! I want to take you to that place in the mountains where your mother and I wanted to live. I want to show you the places where we liked to take walks, the spot where I asked her to marry me, the little park where we had our wedding. Honey, I want you to get to know your dad, and I want so very much to get to know you. I missed so much, and I want to make up for it. I hope you don't get upset when I try to do it all at once.

And I want to meet Kevin. It's going to be so wonderful to come back and reclaim my daughter, and then a few weeks later have a son-in-law, too. I've asked around among the others here and it looks like I'm the only one coming back to a child he never got to know. A few say they're going to look up old

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girlfriends, and some are going to look up old mates that they divorced just like I did.

I'll be home soon my darling daughter.

Love,
Dad

Transmitted: June, 2113

Dear Dad,

I don't know what to say, Dad. I'm so sorry. You know what happened, of course. They moved up the launch date for *Magellan* by a year. Kevin and I got the news in late April. And we both made the final cut. We had a small wedding ceremony at Grandma and Grandpa's, but I'm sure you've seen recordings by now.

It was a terrible decision to make, Dad. I spent a lot of nights crying. Kevin, God bless him, didn't put any pressure on me about it. He said that he knew how important you are to me, and that if I decided to stay, he'd stick with me, and we'd all wait together for the next ship out.

But there might not be any more, Dad. We just couldn't be sure of ever getting the chance to go again. You told me once that exploring new worlds with the person you love is the best of all possible dreams. I couldn't give that up, Dad.

I almost did though. But then Grandpa took me into the backyard and we looked at the stars and he said that he knew what a big decision it was. But he also said that he knew his son, and that if anyone would understand what I was going through, you would. And he told me that you could never have asked for a finer daughter, and that you would be proud of me no matter what I decided.

And he said that you would wait for me.

Will you Daddy? Will you wait?

I am so terribly sorry that things worked out this way.

I don't know what else to say. Please wait for me, Dad. Please forgive me. I'll name a planet after you.

I love you Dad,
Dorothy

Transmitted: August, 2113

Dear Dorothy,

I love you, honey. Of course I'll wait.

Your grandfather met my shuttle at Luna City and told me the news right away. He loves you very much, Dorothy, and if I wasn't inclined to understand on my own, he was prepared to convince me. But I do understand. Still, I cried on his shoulder all the way back to Earth. After all this time I never realized how much I still needed my dad.

Your grandmother couldn't believe how young I looked. My biological age is forty-three, but she thinks I'm only thirty.

And I survived the party. I looked surprised, just like you wanted me to. It was actually a lot of fun. Everyone in town turned out, and I even enjoyed being in the parade.

I visited your mother's grave, but my thoughts there are private. I bought her a bigger headstone, though.

My mom put together a huge electronic scrapbook all about you. It's probably got over a hundred hours worth of stuff on it. You are so beautiful. You were a beautiful baby and you're a beautiful woman. And Kevin

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makes a handsome husband.

I know, honey, that you had no other real choice. I was faced with an even harder decision myself when I went to the stars. I went in search of a dream and found I'd left half of it behind. But you get to have the entire dream.

I decided that I will start teaching this fall after all. I don't need a year off now.

Your grandpa and I once again spend time in the backyard, looking at the stars, and talking about visiting them. But now we have a little girl who is on her way to do just that.

I love you. I'll wait.

Love,
Dad ■

IN TIMES TO COME

● Our April issue starts off with something this magazine hasn't done much lately, but has done to good effect at various times in the past. If you like it, and enough artists get interested in trying it, we may do it a bit more in the future. I'm speaking of a cover which does not illustrate a story in the issue, but is rather a "ministory" in itself. Next month's, by Randy Asplund-Faith, is titled "Eagle's Nest." For now, I'll leave you to speculate on what that means....

Inside, of course, we'll have the usual smorgasbord of science fiction and fact. That will include highly entertaining novelettes by Stephen L. Burns and Michael F. Flynn, short stories by L. A. Taylor and F. Alexander Brejcha, and a fact article by Rick Cook and Pete Manly on the new kind of culture that's evolving on computer nets. Roger MacBride Allen's *The Modular Man* continues, and we round things off with another special feature from an artist: Frank Kelly Freas's thoughtful essay on "The Story Between the Words."

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The Alternate View

HARNESSING THE BUTTERFLY: THE STEERING OF CHAOS

John G. Cramer

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We've just learned something new about chaos. Two recent studies of chaotic systems demonstrate that even when a system is inherently chaotic and unpredictable, it's often possible with small well-timed pushes to steer or even to stabilize it. This comes as a surprise. Up to now a chaotic system has been widely viewed as not only unpredictable but also impossible to control. As we will see, this new insight has interesting implications.

What is *chaos?* About a decade ago the concept of chaos burst upon the scientific community as a new paradigm for thinking about the workings of nature and the structure of mathematics. The new science of chaos staked out its territory in the middle ground between order and randomness, a ground that in the real world is occupied by a wide variety of systems ranging from energy levels in nuclei, to turbulence in plasmas, to water dripping from a leaky faucet, to the spread of gypsy moths, to the weather patterns of the Earth and Jupiter, to the stock and commodities markets.

Physical systems may be either well-behaved and predictable, or they may be "chaotic" and unpredictable, with the latter probably in the majority. There are two key ideas which characterize chaos. First, systems classified as chaotic, while completely determined by initial conditions and the laws of physics, are nevertheless so unstable as to be inherently unpredictable; and, second, that the behavior of chaotic systems is not arbitrarily random but instead shows regularities, repeating patterns, and self-similarities. This new way of looking at chaotic systems came as a great relief to many in the sciences, for it showed that some of the most daunting scientific problems were not just difficult, they were truly insoluble. Moreover, much data that had been shelved as unanalyzable could be recycled and used as evidence for chaotic behavior, and the systematic but unpredictable patterns and structures implicit in the data could be extracted and discussed.

The emergence of the ideas underlying the theory of chaos came from a number of directions: meteorologists trying to predict and understand weather; mathematicians investigating the solutions of non-linear equations and the convergence of recursive procedures; engineers trying to understand the characteristics of fluids in turbulent flow; economists and population biologists and astronomers, all trying to understand systems showing behavior that defied prediction.

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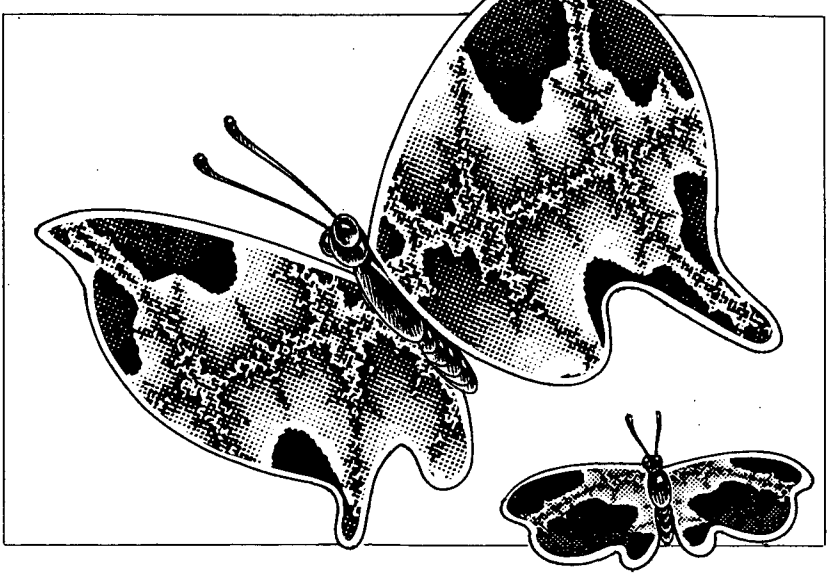
Weather forecasters discovered the Butterfly Effect, which provides a dramatic illustration of the operation of chaos. Using better and better computer models of the operation of weather on a global scale, computer-oriented meteorologists found that the more realistic an atmospheric model is made in including real physical processes, the more unreliable it becomes in predicting the weather on a given day from the atmospheric conditions of a few days earlier. They found that a change in the sixth decimal place in the description of initial temperature or wind direction could result in a completely different global weather pattern a few days later. This became known, somewhat euphemistically, as "the Butterfly Effect": the atmospheric disturbance produced by the flutter of a butterfly's wings in Oslo can a few weeks later result in a major hurricane in the Carolinas. The equations governing the evolution of weather are hypersensitive to starting conditions. The long-sought goal of accurate long-range weather forecasting, which seemed a few years ago to be almost within reach, is effectively impossible. Weather is a chaotic system.

Mathematicians discovered another important idea, the concept of Strange Attractors, which is related to the concept of "phase space." They find it useful to characterize the "state" of a classical physical system by a single point in an abstract multi-dimensional continuum called phase space.

For example, the state of a planet in the Solar System might be characterized by 9 phase space dimensions representing its 3-space position, velocity, and rotation. When the system changes, the point representing its state moves through phase space and traces out a trajectory. In predictable well-behaved



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systems, this trajectory either moves to a point of stability and stops, or else it orbits in the same trajectory over and over. These stable points or orbits are called "attractors" in the jargon of classical dynamics.

In the dynamics of chaotic systems it was first suspected and then proved that the trajectory of the system *does not repeat*. Instead it traces out an envelope within which the trajectory is confined. This is a "strange attractor," an infinitely long nonrepeating mathematical line that never crosses itself and is confined within the envelope of a localized volume of phase space. Using the term coined by Benoit Mandelbrot, such a strange attractor is also a fractal.

There was a 19th-century conceit that with the positions and velocities of all the particles in the Universe, we could completely calculate both the past and the future. Chaos has deflated this notion like the *Hindenburg*, sunk it deeper than the *Titanic*. The Universe is far more chaotic than it is predictable. The ideas and analysis techniques of chaos have been applied in fields ranging from abstract physics and mathematics to economics and population biology. Mathematical techniques have been developed which demonstrate the chaotic nature of a given system and which permit it to be classified. With this new understanding it is even possible to make certain predictions about a chaotic system, for example forecasting average behavior and the likelihood of extreme behavior.

One of the primary tenets of the science of chaos, however, is that it is not possible to predict the future (or past) state of a chaotic system from its present state over more than a very small time interval. In fact, this conventional wisdom concerning the unpredictability of chaos has perhaps gone too far. The current perception is that chaotic systems are not only *unpredictable*, they are also *uncontrollable*. That perception, as it turns out, is false.

In March, 1991, a paper entitled "Controlling a Chaotic System" appeared in the physics journal *Physical Review Letters*. A group of mechanical engineers at the University of Pennsylvania had chosen a particularly simple chaotic system, a closed water-filled circular loop of pipe that is held vertically, electrically heated at the bottom, cooled by a water jacket at the top, and monitored for temperature difference between the "3 o'clock" and "9 o'clock" positions at the midpoints of the loop. The hot water from the bottom of the loop, being lighter, tries to rise and the cooled water at the top tries to sink. This can happen by either a clockwise or a counterclockwise circulation in the loop, which is symmetrically constructed so as not to favor either circulation over the other.

When the electrical heating is low, one circulation pattern or the other at random becomes established and continues. When the heating is increased the system becomes chaotic and the flow pattern can be observed, from variations in midpoint temperature difference, to flow erratically and to change abruptly and irregularly from one circulation direction to the other. Thus they have produced a table-top model of the kind of chaos found in systems ranging from whirlpools and hurricanes to plan-

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etary rings and spiral galaxies.

The Pennsylvania group made a small change in their chaotic system. They changed the power providing the heating coil up or down by about 4% in response to any small rise or fall in the average midpoint temperature difference of the system. This small change, which has the effect of slightly but systematically favoring one circulation direction over the other, eliminated the chaotic behavior of the system. At power levels three times higher than that producing the onset of chaotic behavior in the unmodified loop, the loop with feedback added showed smooth laminar flow.

In May 1991, another paper entitled "Taming Chaotic Systems with Weak Periodic Perturbations" appeared in *Physical Review Letters*. Another group of mechanical engineers, this one at Tel-Aviv University in Israel, used the mathematical model of a pendulum damped by friction and driven by AC and DC electrical forces. They demonstrated that the chaotic behavior of the pendulum could be steered to a desired state through the introduction into the system of weak but well-timed "kicks."

By introducing a periodic perturbation with about 1% of the strength of the other forces in the system, they could drive the system to near-stability. The semi-stable end-point of the system depended primarily on the frequency which the small extra perturbation introduced. Notice that, unlike the water loop, there was no "feedback" in the control of the pendulum. The perturbing signal did not depend on some repeated measurement of the system, it simply gave it a regular kick with a selected frequency.

The moral that can be extracted from these two studies is that chaotic behavior, well known to be extraordinarily sensitive to small differences in initial conditions, is also very sensitive to tiny but *systematic* changes. Chaos can be removed, reduced, or steered by monitoring and feedback, or by introducing periodic perturbations of a carefully chosen frequency.

What is the value of this new insight about chaos? It has many implications. It means, in particular, that we do not have to despair because some system that we are interested in is inherently chaotic. Even though the system in its pristine state many not be predictable, there is still the possibility that we can control or steer it with small perturbation. Consider the weather, for example. If a butterfly in Oslo can unthinkingly cause a hurricane in the Carolinas, then perhaps a few hundred blowers, carefully positioned and carefully controlled by the best computer models of the dynamics of weather, can prevent a hurricane in the Carolinas.

Or consider the stock market. Fortunes are made and lost daily through accurate or inaccurate forecasts of market trends. But it has been demonstrated by economists using the new techniques of chaos theory that the stock market is inherently chaotic and that, like weather forecasting, most middle- and long-term market forecasting is doomed to failure. Moreover, it is well known that the stock market is easily perturbed. A purchase or sale, a leak of inside information, or even a false rumor can send

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the market into an abrupt rise or a tailspin.

What, then, is going to happen when this news has made its way from *Physical Review Letters* to *Analog* and then to Wall Street? What's going to happen when the computer traders realize that they can steer and control the fluctuations and trends of the market by "harnessing the butterfly," introducing small periodic perturbations (perhaps timed buy/sell orders and judiciously dropped rumors) or similar feedback-derived perturbations to drive the market into a predictable state from which money can be made?

As with every new gimmick on Wall Street, for a while someone is probably going to make a lot of money. But when the trick is learned and many operators are doing it, the effects will cancel out and the market, "efficient" as always, will go its own way. This impact of physics and mathematics on economics and finance should be at least interesting to watch.

And remember, folks, you saw it first in *Analog!*■

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●Our responsibility is to do what we can, learn what we can, improve the solutions, and pass them on. It is our responsibility to leave the people of the future a free hand. In the impetuous youth of humanity, we can make grave errors that can stunt our growth for a long time. This we will do if we say we have the answers now, so young and ignorant as we are.

Richard P. Feynman

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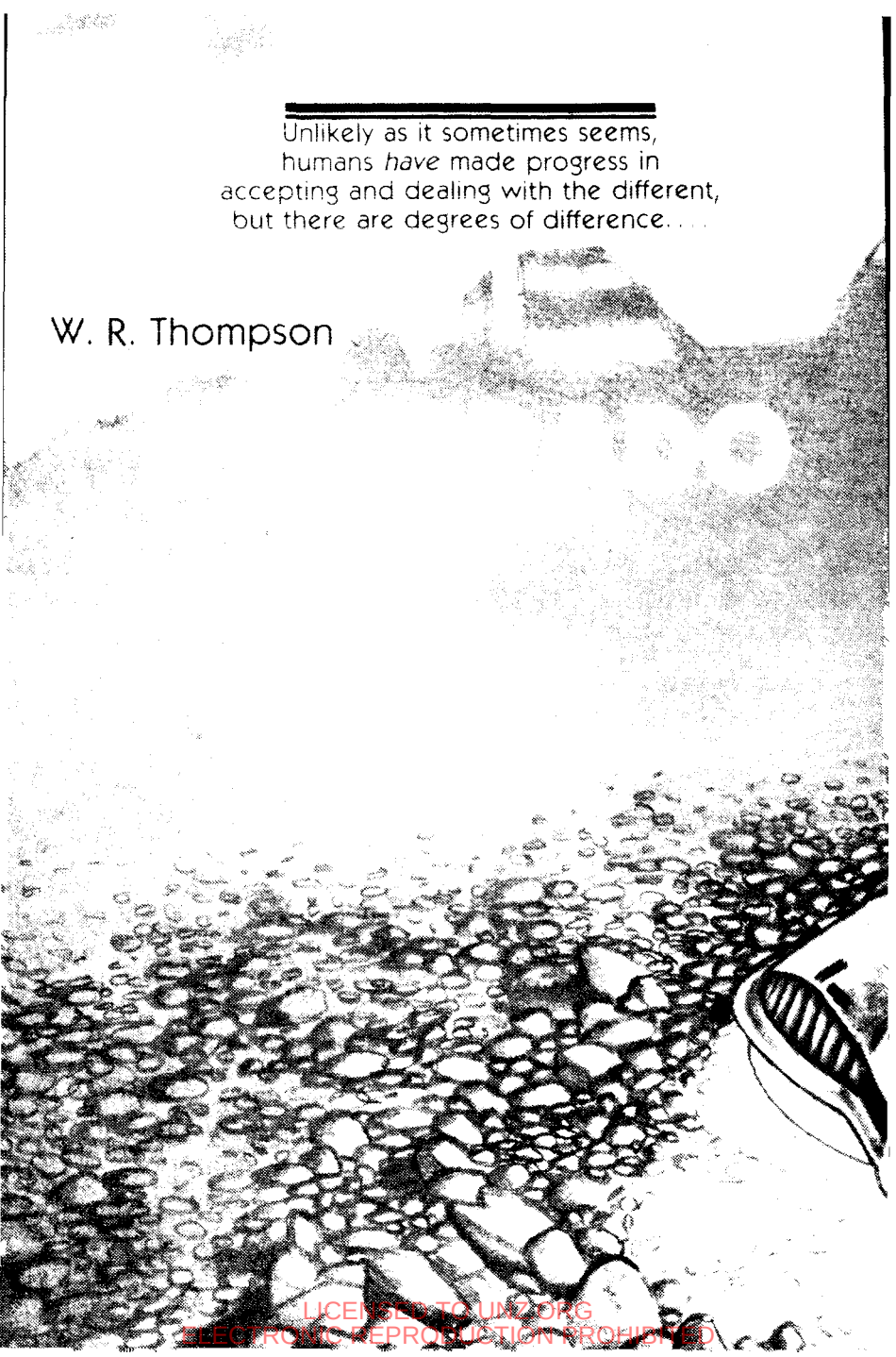
Unlikely as it sometimes seems,
humans *have* made progress in
accepting and dealing with the different,
but there are degrees of difference. . . .

W. R. Thompson



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Mars didn't care who it killed. The unbreathable air, the rugged, poisonous ground, and the solar radiation were as deadly to kya as to humans. The dangers were well-known, but quite real, and that made Mars an ideal training ground for would-be astronauts.

It was also beautiful, Vse thought as the jeep flew toward Tsiolkovskii Base. Beyond the jeep's bubble top, the sky was pink and the ground was a thousand shades of rust; a billion years of wind had eroded the ground into an intricate chaos of dirt and sharp rocks. Plumes of red dust swirled behind the jeep as it sped along on its repulsors.

"Stinking place," one of Vse's passengers muttered. Looking over her shoulder, Vse saw Nikh wrinkle his furry muzzle in distaste. "I'm not sorry to leave."

"I am," Zwil said. "Leaving so soon, I'm sorry I didn't get to see those giant volcanoes."

"Those!" Nikh exhaled in contempt. "Big piles of stone, and if you could smell them—" he tapped the jeep's bubble top "—they'd stink."

"I should hope so," Dlya said patiently. "Being alien, they *should* smell different." Nikh exhaled again. The other passengers—Zwil, and a pair of engineers named Prav and Lev — squinted in distaste at Nikh's rudeness, although the astronomer pretended not to notice it.

Vse stayed out of the conversation. After two weeks—a strictly human measure of time—she had learned to ignore Nikh's complaints about Mars, humans, and everything else. Some people couldn't handle life in space, with its lack of fresh air and open room; a stay on Mars helped screen them out. Nikh would soon find himself riding a passenger liner home to Kya.

Which was his loss, Vse reflected. Earth's UN had agreed to sell the kya a starship. Eventually Kya would build its own ship, but this first ship was important. It would find colony worlds for the kya, establish the kya as equals of the humans—and see plenty of unexplored space. Nikh was a fool to lose that.

The jeep slowed suddenly as a red light flashed on its control panel. "Is something wrong?" Prav asked.

"Definitely," Vse said. There was a scraping noise as the jeep settled to the ground. It came to a rest at an angle—a bad sign, she knew. The repulsors should have held the jeep off the ground.

Vse looked at the instruments. The computer, which did the actual driving, was flashing an incomprehensible warning message in its holo display. Standard procedure was to radio for help, but there was no line-of-sight with either Tsiolkovskii or the outpost, and nobody had placed any comsats in Martian orbit.

So we're on our own, Vse thought. She opened a small compartment and reached for the instruction manual.

The manual wasn't there.

Grumbling quietly, Vse looked at the display. She hoped she could fix this by herself; the jeep had plenty of oxygen, but waiting for a rescue seemed chancy. "Computer, show the systems status display," she said. A translucent holographic image of the jeep appeared, showing wires and modules and cryptic labels. Several of the oblong shapes

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flashed red. One was the power control for the repulsors.

Dlya looked over Vse's shoulder. "I hope we don't have to go out to fix that," he said. He looked at the rugged ground and near-vacuum outside the bubble top. "Being suitless, that would represent a problem."

Vse snuffled wryly. "I think we can fix it from inside. Computer, disconnect the repulsor power unit. Connect the backup repulsor power unit."

A new message appeared in the display: BACKUP IS NONOPERATIONAL.

Vse took a closer look at the display. One of the flashing red oblongs was marked *Rplsr Pwr Sup (2nd)*. Well, she could try other things. "Computer, highlight the power system."

Vse studied the changes in the display. There was plenty of power in the cells; the problem was to get it to the repulsors. Unlike the rest of the jeep's system, the repulsors drew a large amount of electricity, and no other system used that much power. She ordered the computer to reconnect different systems, hoping that a trickle here and a trickle there would do the job. Several times the computer hesitated. Vse wished that the machine had the usual keyboard: the computer had trouble with her accent.

The effort worked. The jeep lifted off the ground and resumed its flight towards Tsiolkovskii Base, although it moved at only half its usual speed. Vse settled back to enjoy the sweet scent of accomplishment. A successfully-handled emergency would improve her chances of being selected for the first kya starship. The humans controlled the training program and selection process, on the theory that their space experience made them qualified to choose astronauts, and competence always impressed humans.

The jeep slowed as it approached Tsiolkovskii. The base was buried under the rusty soil, to shield it against wind and solar radiation. All Vse could see was an observation dome, a scattering of instruments, and several airlocks. The blue UN flag floated above the dome, its ultralight fabric fluttering in the thin Martian air. The outer hatch of the largest lock opened and the jeep slid into a garage-sized airlock.

Dust precipitators cleansed the jeep's exterior. Then a red light in the ceiling turned green as the dust detector verified that the lock was decontaminated. Vse climbed out of the jeep and worked the kinks out of her muscles; the jeep's seats were designed for human comfort.

Farouk al-Taif, the base's second-in-command, appeared in the airlock. "Academician Vse, Director Kostamarova wishes to see you in her office," he said.

"OK," Vse said. "Oh, could you have a technician fix the jeep? We had a glitch in the power supply." She felt proud of the way she casually mentioned the problem.

Al-Taif nodded agreeably and left. Vse bowed to her passengers. "If I don't scent you again, good luck." The others returned her farewell, but Nikh ignored her as he picked up his luggage. Vse wondered why the Kya overgovernment had picked him for astronaut training. He was smart, but abrasive.

Vse went through the air lock's ready room. Spacesuits stood along one wall, looking like a row of empty people. The

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suits built for kya wear mimicked the crouching kya posture, as though they were about to lope off on their own. The human suits looked—uncomfortable, Vse thought. They stood up straight, the way humans did, with legs and spine and neck on the same unpleasant vertical line. She couldn't help thinking of a four-legged carnivore, standing on its rear feet to search the plains for its prey.

Which was unfair, she told herself. Granted, they ate meat, and some of them enjoyed hunting, but those were atavisms. Humans were people, not predators.

Valentina Kostamarova's office was a utilitarian cubicle, although she had softened its metal edges with a few personal touches: some family photographs, an icon, an antique globe of Mars. Having studied the more important aspects of terrestrial history, Vse recognized the globe as the old Percival Lowell vision of Mars, marked with the canals and oases of a dying race. It was a pleasingly romantic touch, she thought.

Romantic or not, Kostamarova was businesslike, as befitted the person in charge of training kya to fly starships. "I'm supposed to brief you on the Mercury situation," Kostamarova said as Vse sat on a stool in front of her desk. She spoke English, which served the humans as a common language. "Mercury is still on course for Mars. We expect it to begin maneuvering in the next forty-eight hours, and to maneuver for several days before it settles into its final orbit around Mars. This is based on what we observed when the Nomads pushed Mercury out of its original orbit.

"We expect two things to happen. First, the Nomad power collector on Mercury will encase the Sun in a collection field. We'll lose our sunlight for the duration. Mars will grow cold."

"I'm familiar with the collection field," Vse said. She had been on Earth six months ago, when the Nomads had used the power collector as a weapon in a small war. For several hours they had encased the Sun in a field which had funneled all of the Sun's energy into several laser beams. Deprived of sunlight, Earth had cooled rapidly while the Nomads fought and destroyed their enemies.

Fortunately the blackout had lasted only a few hours, and Earth had survived undamaged. The lasers had acted as photon rockets, however, and pushed Mercury out of its orbit. The Nomads had announced that this was intentional, and they planned to park Mercury in an orbit around Mars. Once the two planets had settled into a stable orbit around their mutual center of gravity, Nomad-designed robots would strip away the planet's crust and mantle, leaving human industries free to tap Mercury's metallic core for raw materials. The Nomads had said that this was in payment for the inconvenience the battle had caused Earth.

To Vse, the payment reeked of more trouble. The Nomads were selfish, arrogant creatures. With a metabolism based on liquid helium instead of water, they were creatures of deep space: they lived between stars, and saw planet-dwellers as potential servants. The Nomads had no industry of their own, and depended on other races to build what they needed; they had forced kya and humans to sign a mutual-assistance

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treaty with one another because peace and prosperity would ultimately benefit the Nomads.

The alternative to cooperation was racial death. Vse had accompanied a human expedition to a planet called Correy III, where the Nomads had exterminated a race which had refused to cooperate with the Nomads. The Nomads were cold-blooded in more than a literal way.

That made Vse wonder how prominently Earth's well-being figured in the Nomad's plans. "What will this do to Earth?" she asked. "If there's another blackout . . ."

"Earth should be all right," Kostamarova said. "The field forms as a hollow shell, with a radius equal to the collector's distance from the Sun. Earth will be inside the shell, so it will receive normal amounts of sunlight. We're the ones who'll have the problems."

Vse sniffed in agreement. "With the Martian atmosphere cooling rapidly, I suppose the weather will worsen?" she asked.

"Yes," Kostamarova said. "The thermal imbalance will cause dust storms. More serious are the tidal strains Mercury will impose on Mars. We can expect Marsquakes. The base and outpost structures can withstand the predicted shocks, but it's a good idea to remain alert for problems."

"Indeed." Vse didn't like the ambivalent scent of that advice. "What problems can we expect?"

Kostamarova shrugged. "At worst, some minor air leaks, so you'll want to review emergency patching procedures."

"That sounds simple enough," Vse said. Perhaps a Marsquake wouldn't be too bad, she mused. Mars itself was seismically dead; its core had frozen and plate tectonics had ceased a billion years ago, so it could not have much stored energy to release in a quake. "It might even be interesting."

Kostamarova smiled. "That's the spirit! This warning is mostly a formality—the UN doesn't want to see you kya taken by surprise. Oh, while you're here—" Kostamarova opened a desk drawer and got out a small packet. "This arrived for Commander Du-Quesne. Give it to him when you get back."

"Certainly." Vse whiffed the scent of computer memory cards as she took the packet. Avtomats, she decided; there was no mistaking the mix of plastics which went into that particular Russian brand. "Is there a manual to go with these cards?" Vse asked as she put it inside her cloak.

" 'Cards'?" Vse had learned to read expressions on the flat, hairless human face. She saw that her question had flustered Kostamarova. "I don't—is that what it is?"

"I smell Avtomat memory cards," Vse said. She snuffled in amusement at the woman's unease. The kya sense of smell often seemed like magic to humans. "And it seems there's always a manual to go with new software."

"True," Kostamarova said. "But nothing arrived with that package. Well, Academician, I imagine that your new trainees are waiting."

"Yes. *Do svidaniya*." As Vse left the office she felt pleased with herself for recalling the Russian good-bye.

The base had a landing pad for shut-

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tles and an extensible air lock to service them. The shuttle was already down, and by the time Vse got to the air lock her jeep passengers had already boarded the spaceship. Their replacements came out of the air lock, sniffing rapidly at the new scents. There were only three of them, which surprised Vse; most trainee groups ran between five and ten members.

One of the newcomers saw her and put down his suitcase. "You must be Vse," he said, and bowed and sniffed in greeting. "Khri. Captain Khri."

"A pleasure." She returned the greeting, and caught the fellow's pleasant scent. Khri spoke Wideplain with a debonair westlands accent, and his cloak had a stylish cut that displayed his well-brushed fur to good effect. He was a famous aviator, a veteran of numerous test-flights and daring rescue missions, and he possessed the aura of self-assurance which Vse had always associated with fliers.

Steady, dear, Vse told herself. The other newcomers were Tsiv, an unprepossessing fellow with wiry fur and small, bright eyes, who introduced himself as a sociologist, and Chyo, a geologist whose loose cloak and thick fur did nothing to hide the fat which padded her ribs.

The threesome followed Vse to the garage. They were halfway to the entrance when Tsiv stopped in mid-stride and pointed. "What's *that?*" he asked.

Vse followed his gesture. Part of the corridor wall ahead of them was covered with vegetation: a mass of oddly-shaped blue-green leaves. Vse spotted a small dirt box at the base of the plant and snuffled in amusement. "That's ivy. It's a common terrestrial plant."

"Growing *here?*" Tsiv wondered.

"Where else?" Vse asked. "Wishing to soften the harshness of artificial environments, humans commonly keep potted plants." She sniffed. "And the scent is wonderful, isn't it?"

"I think it's a clever idea," Chyo said. She stepped up to the plant, plucked a leaf, sniffed it—and popped it into her mouth. She spoke as she chewed. "Growing a snack in a place like this! And it's delicious."

Vse's mouth opened and shut several times before she found her voice. "Being alien, it could be poisonous. . . ."

"Nonsense," Chyo said. She plucked another leaf and ate it. "Everyone knows it's safe to eat terrestrial vegetation. The amino acids being different from ours, the plants are merely nonnutritious."

"Some of the trace chemicals could be deadly," Vse said. She reached into her cloak and took out her phone. "Doctor Gir, we're coming to the sick bay."

Vse led Chyo and the others to the base's sick bay. Vse, Khri and Tsiv waited in the corridor while the kya physician examined Chyo. After a while Gir joined the others in the corridor. "This being a new problem, I can't say what to expect," the little doctor told Vse. "Chyo seems all right, but that might change. I want to observe her for a few days."

"Do that," Vse said. "Observing her, you might learn how she can live without a brain." She felt annoyed; Chyo's gluttony had just upset the training schedule.

"She has a brain," Gir said. He

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sniffed meditatively. "Lacking common sense, she underuses it. I'd say that when it comes to food, her brain is in one of her stomachs."

"And she gives food enormous thought," Khri agreed. He turned to Vse. "Shall we depart now?"

They went to the garage, where a technician was busily sealing a cover plate on their jeep. "I found your problem," the woman said. She held up a pitted square of a composite material. "This is the cover for the power distributor. Something abraded it, and dust got into one of the circuit bays."

"And caused a short circuit?" Vse asked. She took the square, sniffed and peered at it. The composite smelled all right, but it was badly scratched and pitted.

"The dust was magnetite," the technician said. "The magnetism was enough to scramble the circuits. You lost both repulsor power units, and the controls for the running lights."

"I see." Vse handed the square back to the woman. "I've never seen composite erode this badly."

"Neither have I, but there's a first time for everything. One really good blast of dust and grit, and . . ." She shrugged.

A short while later Vse and her two charges were in the jeep, gliding towards the outpost. Vse brooded while Khri and Tsiv studied the twisted red landscape. The damaged seal struck her as an example of what the humans called Murphy's law. She was more concerned with Chyo's behavior. There had been too many problems with some of the trainees. So far nobody had matched Chyo's stupidity, but the cumulative effect was bad. Enough of this idiocy might make the humans change their minds about handing over a starship.

All she could do about that, Vse realized, was to work as hard as she could. With a feeling of resignation she began her standard welcome-to-Mars talk. "Have both of you been warned about the dust?" she asked. "It's the biggest problem here."

"I've heard about it," Khri said. "Corrosive, isn't it?"

"Corrosive isn't the word." Vse pointed to the sky. "Lacking ozone, Mars is bombarded with ultraviolet light. The soil absorbs this energy and forms superoxides, which react violently with organic chemicals. Accidentally inhaling the dust, you would smell something like boiling acid." She paused.

Tsiv chased after the bait. "And then what?" he asked.

"And then nothing," Vse said. "The superoxides would destroy your lungs. You would die before you could exhale."

"That's nothing to sneeze at," Khri said. He gestured at the red landscape outside the jeep's bubble. "Being everywhere, how does one avoid the dust?"

"Spacesuits and buildings are airtight," Vse told him. "But dust enters when hatches are opened. Fortunately we have excellent cleansers and dust-detectors in the air locks. A red light flashes when there is dust. Shining a green light, the unit tells you that the air is safe."

"Except for the awful way the mumums stink," Tsiv grumbled.

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"I'd leave that kind of talk on the breeze," Vse said. *Mumum* was slang for *human*. It referred to the bland sound of English, which sounded like *mum-mum-mum* to most kya. The word had not found its way into any polite interspecies lexicons.

Tsiv snorted. "You're afraid to hurt their feelings?"

"No. Hearing such talk, they *laugh*—" Vse made a *har-har-har* noise "—because they find anti-human bigotry ludicrous. Personally I hate to smell ridiculous, but don't let me spoil your fun."

"They find us ridiculous anyway," Tsiv muttered. "Arrogant! They think that having slightly better technology than ours makes them superior."

"They *are* ahead of us," Vse said. "By a century or so. Being so, some of them do act smug. But the UN has agreed to share their science and technology with us."

"Only because the Nomads forced them into it," Tsiv said.

"As may be," Vse said. "The point is that they're doing it. Helping us to develop our economy—"

"—we'll become a bigger market for their industries," Tsiv said. "Helping us to grow richer, we can afford to buy more from them. And we'll become dependent upon them. The mumums only help us to help themselves."

Vse began to answer him, then thought better of it. She saw no point in arguing with anyone who saw human help as a trap. For his part, Vse noted, Khri eyed Tsiv in what she hoped was disdain.

The jeep topped a final rise on the Martian surface and the outpost came into view. All that could be seen was a white plastic bubble, tinged red by the dust, and a few posts which held antennae and instrument sensors. The Kya overgovernment's tan pennant flew alongside the UN flag. "Most of the base is underground," Vse said. "It's the Martian atmosphere again."

"The wind," Khri said. "I've heard it can be dangerous."

"The storms are bad," Vse agreed. "The radiation is worse. The air being thin, it doesn't shield the surface from cosmic rays."

"So the mumums burrow underground like rodents," Tsiv said. "Disgraceful."

It's going to be a long couple of weeks, Vse thought in resignation. "The outpost is almost thirty years old," she said. "It dates back to the early exploration of Mars. Having a number of negative qualities—little room, bad odors, outdated equipment and complicated controls—it makes an ideal training ground. If you can survive here, you can survive anywhere."

The jeep entered the outpost air lock and was duly decontaminated. The trainees got out of the jeep with their luggage, and Vse took them through the ready room and down a spiral staircase. The outpost was a collection of cylindrical modules, linked together to form a single level under the Martian surface.

Tsiv's muzzle twitched as he checked the new scents of the outpost. "Interesting," he said. "Do I smell fresh stripleaf?"

"Among other plants," Vse said. "Part of this outpost is an ecological research lab. We want to know how well our plants will grow on colony

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worlds, and what we'll need to assure their growth. Establishing a functioning ecology takes more than sticking a few seeds in the ground and hoping it rains," she added.

Khri sniffed appreciatively. "Hearing this, I recall reading that you're a biologist."

"I am," Vse agreed. "One of my duties here is ecological research. I share the work with two other scientists—"

"It goes well?" Khri asked.

"Yes, the plants do quite nicely," Vse said.

"Good." Khri inhaled deeply. "Having been—inside—ever since I left home, I'd like to see the plants some time."

"I think I can arrange that," Vse said as they came to the wardroom, where two of the outpost's three human staff sat playing poker. They were both male, with thick, short hair on the lower part of their pink faces. Vse thought the hair made them look a little less alien. The human head resembled the kya form, but the details—eyes with white-rimmed pupils, sharp teeth, tiny, convoluted ears—spoiled the effect.

One of them looked up from his cards. "DuQuesne wants to see you, Vse," he said. He tossed a plastic chip onto the table's center. "He doesn't seem any madder than normal."

"I hope that's a good sign," Vse said. She introduced Khri and Tsiv to the humans. "Joseph Blake is our technological advisor, and Ivan Tumansky is a botanist," she explained. "Joseph, could you show Khri and Tsiv to their quarters?"

Blake nodded. "Have a pleasant time with the Duke," he said.

With a wry snort Vse left for the outpost's control cabin. DuQuesne had a reputation for being—less than considerate, Vse thought diplomatically. The man often seemed unfair to his subordinates. That included humans, but he was especially hard on kya. Vse anticipated a tirade about the unsuitability of herd animals to spaceflight, which was his favorite topic.

Vse found DuQuesne sitting in the far end of the control cabin, where he glowered at the instrument panels surrounding him. He was a large, muscular man in his early sixties, with short gray hair atop his head and a face as wrinkled as any kya's muzzle. "Oh, it's *you*," he said, looking up at Vse. "Did you bring all the trainees?"

"Er—not exactly, sir—"

" 'Not eksakly sirr,' " he repeated, exaggerating her accent. "How many *did* you bring? One and one-half? Two-point-eight-one? Have I got a fraction of one of you wankers on my hands?"

"Khri and Tsiv are here," Vse said. "Chyo is under observation in the base sick bay."

He grunted. "What's the problem?"

"Bad judgment. She ate some ivy leaves—"

"And you didn't stop her?" DuQuesne demanded.

"She was faster than me," Vse said. "Seeing her sniff the ivy, I never thought she would eat any."

"You didn't think, period." DuQuesne shook his head in disgust. Humans had a large number of gestures which expressed disgust, and in the past several months DuQuesne had exhibited them all. "At least you saved me the

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trouble of washing her out later," he conceded. "Speaking of wash-outs, Tsiolkovskii reported that you had trouble with your jeep."

"Yes, sir, there was a minor malfunction—"

"You call a primary power failure *minor?*" he demanded. "Why didn't you report this at once? I *know* you wankers invented the radio, so don't claim ignorance."

"We were out of radio range, sir. And the problem was easily handled by rerouting the power supplies."

He smiled nastily. "The instruction manual told you how to do that?"

"Uh—"

"You *did* check the manual, didn't you?"

"There wasn't one," Vse said.

"So." He leaned back in his chair, a pleased look on his face. "You left the outpost without verifying that you had all of your equipment. You idiot—people get killed that way. *This* won't look good on your record. Now get out."

"One thing." Vse pulled the packet from her cloak pocket. "Kostamarova asked me to deliver this."

DuQuesne took the packet and opened it. Several memory cards spilled onto his lap. "Where's the manual?" he demanded.

"Kostamarova said there wasn't one."

"Figures," DuQuesne said. He pushed a card into a computer slot, then glared at Vse. "Now scram. Go cough up a hairball or something."

Temper, Vse cautioned herself. It was bad enough that he had turned her successful handling of an emergency against her. Losing her temper would let DuQuesne put another negative mark in her fitness report.

Vse left the control cabin and went to the ecological lab. The three linked modules were filled with planters, sunlamps, and automated sensors. The artificial light was a good deal more yellow than that of Kya's sun, but the plants flourished under it. Vse plucked a berry from a bluedot bush, sniffed it, and tasted it. Perfect, she decided. DuQuesne might have derided her for not using instruments, but the scent and taste told her that bluedots grew well in the imported terrestrial soil.

Klou was at work in the rear of the farming area, taking a soil sample. "Good to scent you again," the elderly scientist said absently. "How was the trip?"

"It stank," Vse said, and told him about the accident and Chyo. "DuQuesne blames me, of course," she finished.

"He is blameful," Klou agreed. He sniffed a soil sample and peered at one of the dirtbores wiggling in it. "A strange one, would you say? DuQuesne, not the insect."

"Strange, yes . . ."

"Compared to other humans?"

"Well—"

"Humans make you nervous," Klou said. He snuffled before Vse could speak. "Think on this. Humans smell strange, look strange, sound strange. Being alien, they perforce act alien—"

"It makes them interesting," Vse said. "And . . . exciting, I think."

"And scary." Klou idly stroked his furry muzzle. "Lacking much hair, they look diseased, no? And they eat half-burned meat. Certainly their diets

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give them a carnivorous aroma."

"Speaking so, does that bother you?" Vse asked.

"I think it bothers you." Klou took a probe from his belt kit and sank it into the soil. He spoke as he studied the probe's readings. "Ever since you arrived you've seemed tense. Thinking about this, I wonder if—"

"—if I'm scared of humans?" Vse sniffed meditatively. The suggestion distressed her . . . but Klou was no fool . . . and only an idiot ran away from good advice. "It's something to think about," Vse said.

With that, Vse went to work. Although most of the actual labor was done by robots and computer-directed remotes, somebody still had to tell the machines which data to take, how much water to give the plants, and how much to brighten the lights for the next phase of the experiments. Machines could no more make those decisions than they could enjoy the results of their work.

Vse's telephone rang. "Vse listens," she said, pulling the card from her cloak.

"Khri speaks. Dinner being ready, would you care to join us?"

"Certainly." She checked the time and discovered that she had worked through most of the dinner period, while not accomplishing much. Klou's comments had left her preoccupied.

All of the outpost staff except DuQuesne were in the habitation module's wardroom. The commander preferred to eat alone, either in his cabin or in the control cabin. Tumansky and Blake murmured quietly to one another—and it *did* sound like *mum-mum-mum*, Vse thought in self-annoyance—while Klou chatted with the trainees.

"Our results have been excellent," Klou told them, while Vse sat down with a tray of breads, vegetables, and cheeses. "Growing so well here, I think our plants and animals will do well on colony worlds. We now direct our work toward finding optimum establishment patterns—which organisms to introduce into the new environment, what numbers are required, and so on."

"There are still unknowns," Ivan Tumansky said in Wideplain. "Seasons and lunar phases could disrupt your lifeform. We had to abandon Novaya Zemlya because it had two big moons," he added. "The double cycle was too much for our colonists. Some people got ill, and the women had fertility problems."

"I thought the trouble was that Novaya Zemlya didn't have an adequate geomagnetic field," Blake said.

"That was Norstrilia," Tumansky said, with a shake of his head. "Lunar cycles, magnetism—I'm surprised we've found three worlds we can colonize."

"Four," Blake said. "Barsoom has a little moon in a forty-day orbit. The UN is using microbots to turn its surface into a mirror. It should reflect enough light to simulate lunar cycles."

"That's still experimental." Tumansky sighed. Vse reminded herself that among humans such exhalation signified frustration or resignation, not rudeness. "I hope you kya have better luck than us."

"We surely have our own environmental limits," Klou remarked. "It's a path we still have to explore fully."

"But not tonight," Blake said. He

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nodded to Tumansky, and they left the wardroom together.

Vse picked at her food. The problems humans had with colonization were depressing; unlike Kya, Earth had seasons, a strong magnetic field and an outsized moon. That had shaped the evolution of terran life, and the long-term survival of that life required factors which at least approximated those conditions. No wonder DuQuesne was so grouchy, Vse thought. It must have been a terrible disappointment to find that much of the galaxy was closed to his species.

"A question," Khri said after the two humans were well beyond hearing. "Which of them is the female?"

"Neither," Klou said. He nibbled a piece of bread. "They're both male."

"Really?" Khri's muzzle wrinkled in confusion. "But—behaving as they do, they seem like lovers. They certainly carry one another's scent," he added.

"That proves nothing with humans," Vse said. Humans touched one another with a shocking lack of concern, casually mingling sweat and body oils. Kya, with their sensitive noses, were far more fastidious. Carrying the scent of another was a sign of intimacy.

"They're lovers," Klou said. "Sometimes humans of the same sex do that. The library computer having some data on the topic, you might read . . ."

Vse tuned out the conversation. Human sexuality was a topic which had always puzzled her . . . and made her uneasy, now that she thought of it. The realization vexed her. She had come into space to find strangeness, and when she found it, something in her didn't like it. She thought she got along well with humans, and counted several as friends, and yet . . .

Vse finished her meal and went to her cabin. A small robot was climbing the walls, scrubbing the paint in an effort to remove absorbed odors. An oblong cot hung from a bulkhead; designed for human use, it was twice the length of a kya sleeping pad. It would make a nice double bed, Vse reflected as she climbed onto the cot. Lately she had been too busy for anything but work, but with only two trainees on the schedule she might find the time to get better acquainted with Khri.

Vse got into a comfortable crouch, resting her hands on her knees and pillowing her chin on her hands. The cabin dimmed its lights when she closed her eyes, but it was a long while before she slept.

She was back home, in a dream, roaming an endless path in a forest . . . endless, she realized, because it was a looped path, circling the same tiny patch of trees and brush. It was stultifying in its sameness, and she would have left the path gladly but the woods were so thick as to be impassable—and they *stank*, horribly, with a slowly thickening stench of decay.

Vse woke up. Klou hadn't done her any favors with his advice, she thought. As in her dream it left her feeling hemmed in, as though it confined her to a tiny part of the world, or as if she had confined herself, she thought. Vse wished she could ignore what he had said, but she knew she wouldn't have felt so unhappy if Klou hadn't been at least partly correct.

And the dank odor of rot remained in her nose. Vse sneezed, then took a

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careful whiff of the cabin air. The odor was real, and very close to dripmold—a bit more acidic, perhaps, but too close to be anything else.

She got up, pulled on a cloak and went to Klou's cabin. "Smell that?" she asked, as the elderly scientist stood blinking in his doorway.

"I smell it." He and Vse hurried to the lab.

The stench made Vse stagger when the hatch swung aside. When the lights came on she saw that many of the plants were covered with oozing yellow splotches. "Dripmold," Vse said.

"Not smelling right, it *can't* be dripmold," Klou said. He went to a dying plant and peered at a leaf. "Yet it does look like dripmold. But growing so fast—" He exhaled in anger. "Needing fungicides, let's check the stockroom."

"We don't have enough for this," Vse said. She got out her phone. "Tumansky? Tumansky, Vse speaks. There's trouble in the lab."

Tumansky stumbled into the lab a moment later, accompanied by a bleary-eyed Blake. "What's this?" Tumansky asked, looking at the dying plants.

"It looks like dripmold," Klou said, "but not smelling like dripmold, and spreading much faster than dripmold, I can't say what it really is."

"Could be a mutation," Blake said.

"Yes," Tumansky said. He looked at the plants. "It's bad luck if a mutation led to rapid growth. We're going to lose a third of the growth here, Klou, or even half. Joseph, have you got a mike to handle this—" his nose wrinkled in a kyalike gesture of revulsion "—situation?"

"We have a template for a general fungicide," Blake said, "but it won't kill nonterrestrial stuff."

"I know," Tumansky said. He gave his short beard a thoughtful stroke. "Klou and I will analyze some samples and see what we're fighting. Then we'll give you the parameters. Vse can double-check the biological factors."

Vse followed Blake to the computer room. It was primarily a storage area, filled with raw materials for the nanotech factory: pure elements and simple compounds, stored as gases, fluids, or powders, connected to the factory box by a maze of tubes and ducts. The factory itself was a simple box, broken only by a keyboard and an output slot.

Blake sat down at the machine and the holographic display appeared above the box. As he worked a molecular image appeared in the display. To Vse it looked like a ball with a long shaft running through it. "It's a basic switchblade," Blake said. "The ball's outer surface is a chemical detector. It fits itself to the proteins on the fungus' skin. The inner surface acts like a spring. It drives the shaft into the target cell, then pulls it out. The blade doubles as a pogo stick to propel the mike."

" 'Pogo stick'?" Vse repeated. *Mike* was short for *microbot*—humans liked to give simple names to common devices—but *pogo stick* was new to her.

"Clever," Vse said, after Blake explained the term. It wasn't the sort of thing a kya could use. Surviving a ride on a pogo-stick would require a sensitive balance-sense. Humans had inherited such a sense from their tree-dwelling ancestors, but the kya inner ear was not that delicate. "Can the mike drive the shaft through either of its ends?"

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Vse asked.

Blake nodded. "What have you got in mind?"

"Molds reproduce through spores. We might use one end of the mike to kill actual cells, and the other to kill spores."

"Good idea," Blake said. "We can't leave the spores to infect the place again."

The display cleared itself and new data appeared as Tumansky and Klou finished their work. Blake knew little about biochemistry, so Vse had to sort through the data to identify the chemical structures on the surfaces of the fungus and its spores. Once he had that data Blake used standard algorithms to design molecular receptors which would let the mike hunt and kill its targets.

Ten minutes after Blake had sat down at the computer, a fine mist hissed from the factory's output slot. "The spores are everywhere by now," he told Vse, "so we'll let the air system spread the mikes for us. The mold should be dead in another fifteen or twenty minutes."

"What mold?" DuQuesne demanded as he came into the computer room. "I hope like hell *somebody* has a good explanation for what's going on."

"We had a contamination emergency in the lab, sir," Blake said. "A kya mold got loose, and—"

"—and you bent over backward to help the wankers," DuQuesne said. "Goody for you. Now scram. Go bend over forward with your buddy while I talk to Fumblethumbs here."

"An emergency," DuQuesne said to Vse, after Blake had left. He stood with his arms crossed and his feet spread, a confrontational pose in human body language. "Hello, remember me? The boss? You're supposed to tell me when there's trouble."

"There wasn't time, sir," Vse said. "This was a fast-growing mutation—"

"—which wouldn't be here at all," DuQuesne said, "if some chucklehead on Kya had decontaminated your supplies."

"Accidents happen, sir," Vse said.

"Yeah, I've noticed. Mostly they happen around you wankers. I'm not surprised. Herd animals can't function by themselves—it really does take five kya to change a light bulb, doesn't it?"

The joke slid past Vse. "No, sir, only one. And we aren't herd animals—"

"Have you got a better explanation for all the screw-ups around here?" DuQuesne waved a hand in disgust as Vse started to speak. "Don't say it. I've heard all that claptrap about culture shock and future shock and environmental stress and—ah, to hell with it. You wankers can't handle being away from the rest of your herd. Kya don't belong in space."

"Being in space for some time, I've done all right," Vse said.

"And I'll bet the other wankers think you're weird, getting along without the rest of the herd." DuQuesne shook his head. "I admit I was halfway impressed with you—until now. Now I don't think you can cut it. Go on, get out." He gestured at the door.

"I—" Vse began.

"Beat it," DuQuesne said in irritation. "I've wasted enough time on you. Right now I want to make sure this dump is secure before Mercury kicks up some Marsquakes."

Despondent, Vse went to the lab. She

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saw that the dripmold was already dying, becoming a thin yellow liquid which splashed into the planters and onto the metal decking. The fungus might have been stopped, but half of the plants were dead or dying. Assorted bacteria and insects would die with them, Vse knew. The entire ecology might collapse. She had to wonder if it could be reestablished, or even if the effort was worth making.

Tumansky was in the lab, kneeling over a puddle with a scanner. "Klou wants a full analysis of the mold," he said. "He's scared witless about what would happen if it got loose on Kya."

"There's no chance of that," Vse said.

"Klou wants to play it safe." Tumansky looked up at her. "You sound low. Did you have another run-in with DuQuesne?"

"Yes. He's more upset than normal."

"Don't worry about him." Tumansky switched off the scanner and sat on the deck. At an invitational gesture Vse crouched with him. "Do you know DuQuesne's background?"

"Slightly. He joined the American space program over thirty years ago. He was on the second Mars flight, the first Saturn mission, and the first starship. Quite a record," Vse admitted.

"Joseph told me a lot more about him," Tumansky said. "Did you know that when DuQuesne started in space, there were less than a hundred cosmonauts in the entire world?"

Vse let out a mild *gronk* of surprise. "I thought Earth had thousands of cosmonauts by then."

"Thousands of people went into space," Tumansky said, "but they were passengers. Not many people were trained to fly spacecraft, back when they used rockets and just getting into orbit was a major feat."

"So DuQuesne was part of an elite?" Vse asked. "I think I smell the problem."

"It's ego," Tumansky agreed. "There's nothing special about being a cosmonaut when assembly lines turn out starships and hobbyists build orbiters in their garages. He hates anyone who doesn't 'belong' here; it reminds him how much things have changed."

Vse sniffed thoughtfully, then sneezed at the odors filling the lab air. "The idea of giving a starship to a bunch of 'wankers' must twist his nose," she said.

"It does," Tumansky said. He idly pulled at his beard. "Frankly, I think his nastiness is the reason Kostamarova chose him for this job. Trainers are supposed to give their students a hard time, to toughen them up. So don't let him get you down."

Standing in the ready room, Vse watched Khri and Tsiv as they suited up. The spacesuit design was called "idiot-proof," but Vse felt it was a good idea to make certain that neither fellow found an ingenious way to kill himself. She read off a checklist for each step, and got bored answers from her students. Blake sat in the control cabin, monitoring the radio chatter in case of trouble.

Vse got into her own suit while Khri ran down the checklist with her. Waistband, gloves, and helmet locked into place; plastic-scented air pumped

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through the helmet; the radio worked and the helmet display gave proper readings. The tips of her ears brushed the inside of the glass bubble, but she had grown used to that nuisance.

"That's it," Khri said, putting the checklist on its shelf. He tapped his faceplate and snuffled wryly. "Being ready, shall we go out and sniff the scents?"

Vse snuffled dutifully at what was already the stalest joke in kya astronautics. "We won't try anything clever at first," she said as they left the air lock. "Walk around, get the feel of your suits and learn to keep your balance. Don't worry if you fall. The helmet is shatterproof."

"What about tears?" Khri asked. His boot tapped a rock which had been given sharp, jagged edges by windblown grit.

"You *could* tear your suit," Vse told him, "but the material is so tough you'd have to work at it, in which case a tear would serve you right."

"Reassuring," Tsiv said absently. Vse saw him look around, his muzzle twitching in fascination. Under the pink sky, a field of jagged red boulders and cobbles stretched toward the dark horizon. The gritty red soil retained corrugated footprints in a few places, but a swirling dust devil promised that the marks would not remain long. "It's . . . overpowering."

"Yes, I had no idea there were so many shades of red," Khri's debonair tones made him sound unimpressed. "Vse, is that a crater over there?"

"It's part of one," she said. The outpost was sited north of a city-sized crater. Windblown sand had eroded gaps in its rim, and its bottom was filled with dirt.

"Is it safe to enter?" Khri asked. "I'd like to see the interior."

"Follow me," Vse said. "Joseph, we're entering the crater. We'll be out of communication for a while."

"Understood," Blake answered from inside the outpost.

Vse slowly led them through a breach in the crater wall. A laser had cut a path along the inner wall, and it curved toward a garbage dump. Much of the rubbish had been blown farther into the crater by the wind, and some of it had been partly oxidized by the dust. "Be glad you're wearing helmets," Vse said. "The only nice thing about this trash heap is that we can't smell it."

"Yes," Khri said. He looked back along the path. "Can anyone hear us now?"

"No, the crater wall blocks our transmissions," Vse said. "Does that bother you?" She recalled DuQuesne's comments about herd animals. There was some truth to the remarks, she knew. Kya were a good deal more social-minded than humans.

"It doesn't bother me," Khri said. "We need a private moment. Vse, Tsiv, did you notice anything strange about that dripmold?"

"What was there to notice?" Tsiv asked.

"The speed with which it spread."

"It was a peculiar mutation," Vse said. The three of them had gathered into a cluster, their helmets almost touching one another. DuQuesne would say we're huddling like herd animals, Vse thought idly. "Mutations happen often in nature."

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"What if they do?" Khri asked. "Vse, isn't it true that humans can tailor organisms?"

"Yes, within limits," Vse said.

"Suppose they tailored dripmold to grow rapidly—"

"Why?" Tsiv asked. "What good is dripmold?"

"This mutation makes an excellent weapon," Khri said grimly. "Possessing it, they could devastate Kya's agriculture and exterminate us. Alternatively, they could coerce us into doing whatever they desired."

"But why would they make a cure for it?" Tsiv asked.

"To control it, of course," Khri said. "And notice the ease with which they found the cure. Being *too* easy, I think they already had it on hand, to keep the weapon under control—"

Vse snorted in shocked amusement. "Oh, really! Having watched Blake create the cure, I know everything's as honest as it smelled."

"They put on a nice act," Khri said. "But you know they have a bioengineering facility on Mars."

"I've visited it," Vse said. "I didn't smell any Kya organisms there."

"You can't be certain," Khri said.

Vse snuffled "I can be certain. The lab's 'airtight' seals leaked abominably." Which was why, she reflected, the humans did their engineering work on Mars. The active Martian soil would destroy any organism which escaped from the lab.

"Well . . ." Khri hesitated. "Well —what if the humans have built another genetics lab on Mars? Or on another planet?"

"Irrelevant," Vse said. She stepped back from the others and gestured at the bleak red landscape. "Our only physical contact with the outside world is through the jeeps. For the past few months either Klou or I have ridden *all* of the jeeps between here and the base. We would have scented any dripmold."

"Not if it was carefully sealed," Khri said.

Vse snuffled again. "Humans don't know how to make scent-proof containers. Things being what they are, this incident can only be an accident. A spore slipped through decontamination back home, took root here, and mutated."

"I don't know," Tsiv said suddenly. "That's plausible, but—I don't know."

"I *do* know," Vse said firmly. "It's impossible for the humans to have created this mold. And even if it *was* a weapon, why would they let us know it exists?"

"I suppose you're right," Khri said. "Talking with DuQuesne last night, I have to admit feeling some uncertainties about humans."

"I can understand that—" The ground trembled under their feet, interrupting Vse. The shaking lasted only a few seconds, but it startled her. "Let's head back to the base," she said. "And, Khri, let's stay upwind of that weapon talk."

"I suppose it *does* have a certain ripe odor," he said ruefully. "As you wish, scented one."

Vse led the others back through the gap in the crater rim. "We felt the quake, Joseph," she said when the base was in sight again. "Was there any damage?"

"No, we're fine. Oh—Klou wants

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you to help him in the lab. He's ready to reseed the planters."

"He is?" Vse asked.

"Yeah. He's pretty excited about it," Blake added. "He keeps mumbling about a great opportunity."

Wondering what opportunity the old scientist could find in widespread rot, Vse led the trainees back inside. They doffed their suits and went to the lab, where Klou and Tumansky were uprooting ruined vegetation. The air filters were hissing at full capacity, but the air remained thick with the odors of decay. "Recycling the dead organics, we can use them as fertilizer," Klou was saying to Tumansky. He sniffed and caught Vse's scent through the decay. "Oh, there you are. Marvelous opportunity here, youngsters. There's a planting schedule in the computer. Grab some seeds and start working."

"The planting robot would be faster," Tumansky said.

"Nonsense. Why let a machine run off with all the fun?" Klou went to the nearest computer work station. It was designed for erect-standing humans, and he had to crane his head to read it. "Start with the bluedot and stripleaf seeds. Then we'll spray on the bacterial mix. Marvelous, marvelous!"

"*What* is marvelous?" Vse asked impatiently. An automated cart had rolled up to Tumansky, who began to stuff dead shrubbery into it. On the deck, a cleaning robot sopped up the last of the dripmold splashes. Vse saw no marvels here.

"This opportunity." Klou sniffed and looked at her. "What happens if a disaster like this hits a colony, or Kya? Defeating the mold, or a similar infection, how do we recover?"

Vse sniffed in delight. "Here's a chance to learn how," she said.

"Exactly," Klou agreed. He waved a short, furry arm at the lab. "Here we have a traumatized ecology. Many dead plants. Dying insects and micro-organisms, upset rhythms, every possible imbalance in full stampede. The worst stench since the Mr'lek Stormlords got a whiff of themselves! Can it recover? If so, which path to recovery is best? What mistakes should we avoid?"

Vse sniffed deeply in admiration. Klou had turned the disaster into a wonderful and invaluable experiment. "Crop diseases being a major problem, like that crumblerot plague in Longvalley, we could learn things to help farmers," she said.

A moment later Vse was planting seeds in the half-dead soil. Scrape a hole with a finger, drop in a seed and cover it up. The kya hand had evolved from the root-digging paw of a remote plain-dwelling ancestor, but after an hour of gardening Vse decided she knew what had prompted her ancestors to evolve into a higher form. "I'm taking a break," she announced, brushing soil from her cloak.

"I'll follow you on that," Khri agreed. He had worked without enthusiasm. "I've had enough daring adventure on strange worlds for one day."

"Nonsense, gardening is marvelous fun," Klou said. "Quite a change from metal and plastic, isn't it, Tumansky?"

Tumansky nodded. "Not to mention permafrost. Nobody ever gardened back home in Siberia."

Leaving them to their pleasures, Vse went with Khri and Tsiv to the ward-

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room. A dispenser slot rolled out trays of preprocessed food. They sat on stools and balanced the trays on their knees as they ate; the stools were built for kya use, but the wardroom table was fixed at an inconvenient height.

"I don't know," Khri muttered to himself.

"Know what?" Tsiv asked.

"Well . . ." Khri sniffed thoughtfully. "Being a sociologist, Tsiv, what can you tell me about omnivores?"

"Such as humans?" Tsiv's nostrils fluttered. "I'm not sure that what we know about Kya's omnivores applies to them."

"Perhaps," Khri said, "but I've heard it argued that all omnivore psychologies are unstable."

"They're a bit unpredictable," Tsiv said. "Omnivores will eat normal food for a long while, then get a craving for meat and pounce on the nearest animal. This instability is an instinctive urge—omnivores *need* meat—and they can't help themselves—"

"Nonsense," Vse said. "This is like humans saying we're natural pacifists because we're herbivores, when we're really about as warlike as they are. Biology isn't psychology."

"True, but they *are* omnivorous—" Tsiv began.

"I give up." Vse stood and slid her tray into the disposal slot. She thought about saying something cutting, but settled for exhaling loudly at Tsiv, *get your stench out of my nose!*

Vse spent the next hour in her cabin, idly brushing her fur while she wondered how life could go so badly. Humans made her uncomfortable, but people like Tsiv and Khri were worse. They seemed to want problems, to drive wedges between humans and kya. And Khri had seemed like such a nice fellow. What did it say about her that she still felt attracted to him?

She heard a tap at her door. Putting the brush aside, she answered the call and found herself looking at Tsiv. "Oh, it's *you,*" she said. "Go sneeze on yourself."

"Some other time," he said. "Right now I want you to get a whiff of something, then give me your professional opinion."

Reluctantly, Vse followed him to the air lock. Tsiv went to the garbage bin and opened its lid. Taking tweezers from inside his cloak, he reached into the bin and retrieved a finger-sized length of glass tubing. One end was jaggedly broken. "Smell this," Tsiv said.

Yellow fluid dripped from the tube as Vse took it. She smelled dead fungus . . . assorted garbage . . . Khri's scent—"What *is* this?" she demanded.

"It's how the dripmold got here," Tsiv said. "You were right about one thing, but you had the emphasis wrong—*humans* don't know how to make scent-proof containers. *We* know how."

Vse stared at the tube. Khri's scent on the glass could only mean one thing. "Khri brought this here."

"Yes. Thinking the trash went straight outside, he put the evidence here."

"Once outside, the dust would corrode his scent," Vse said. "But—why would he want to destroy the lab?"

"Because—let's start at the beginning," Tsiv said. "Have you noticed anything odd about any of the

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trainees?"

"Some of them have reeked with incompetence," Vse said. She felt thoroughly bemused by Tsiv's question. "Lack of imagination. Bad manners. One or two people in each batch of trainees obviously don't belong here."

"Not 'obviously,' " Tsiv said. "There have been a number of trainees with character flaws. Slight flaws, but they become dangerous in the right conditions—get a whiff of Chyo's gluttony. Yet certain politicians have arranged for such people to enter the training program."

"To sabotage the starship project?" Vse asked.

"More than that," Tsiv said. "The plan was that the humans would reject these foul breezes. Justified or not, enough rejections would make it seem they have a low opinion of us. This would cause resentment, which would lessen human influence on Kya."

Vse sniffed. The logic held together. And yet—"What's the point?" she asked. "Human influence isn't great back home."

"It's growing, and it scares some leaders," Tsiv said. "They see power as a limited thing. If human influence expands, their own leadership must contract, right?"

"I think I understand," Vse said sadly. She went to the air lock exit. There was a small window in it. She saw that the landscape and sky were darkening; the sun was setting. There was a small, dim crescent low on the horizon: Mercury, making its approach to Mars. The scene was alien, but not beyond comprehension, unlike this demented lusting after power.

Then she sniffed out a flaw in Tsiv's story. "What about the dripmold? If it isn't natural, where did it come from?"

"It was created on Kya, at a secret lab in Longvalley—"

Vse gronked in shock. "*Our own people* made it?"

"Yes. A number of pathogens were exposed to radiation. It was a clumsy method and most of the mutants were harmless. A few were somewhat dangerous—such as the crumblerot, whose accidental release led to the lab's discovery—but they cooked up an especially virulent dripmold before we shut them down."

Vse gave a thoughtful sniff. Something similar had happened on Earth, thirty or forty years earlier, when terrorists had created a minor plague by irradiating influenza viruses with X-rays in a crude lab. So far Tsiv told a plausible story. And yet—"How do you know all this?"

"I'm a spy," he said, idly brushing the wiry brown fur of his forearm. "I *am* a sociologist, but I work for the overgovernment's spy service. Investigating the Longvalley plague, we stumbled onto an isolationist conspiracy. We broke it up—"

"—but Khri escaped?"

Tsiv snuffled, although not too happily. "He was allowed to escape. Not knowing the names of the conspiracy's off-planet members, we hoped he would lead us to them. Some of them have samples of the dripmold. They plan to contaminate human ships with it. Landing on Kya, it would smell as if the humans intend to infect the world."

"So by contaminating the lab here, and burping out his suspicions, Khri

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was setting the stage for that story." Vse snorted in sour amusement. "But it wouldn't work. Having the microbot cure—"

"—the humans could nullify the plague." Tsiv's muzzle wrinkled. "I know. But I don't want us to owe them too much, and it would embarrass the overgovernment to have this exposed."

"Would a plague and famine be less embarrassing?" Vse asked. Then something occurred to her. She realized she knew little about espionage, but it seemed strange for a spy to expose himself. "Why are you telling me all this?"

"Because I need help," Tsiv said. "I'm trying to gain Khri's confidence. That'll be easier if he thinks other people believe his nonsense. So do what I've done. Don't argue against him; let him persuade you that humans are evil—"

"No," Vse said. The thought made her shudder; it was too close to the things rattling around in the danker corners of her mind.

Sensing her revulsion, Tsiv decided not to press her. "Then do me one favor. Keep acting like you think I'm a clog-nosed bigot. I *must* gain his confidence. Doing that, we can find the rest of his conspirators—and the dripmold cultures."

"If you can't," Vse said, "I hope someone will have enough sense to ask for help." She hoped it wouldn't prove necessary. Aside from patriotic pride, she didn't want to witness the sort of disaster which would make it necessary.

"I suppose someone will," Tsiv said. He sniffed as Vse went back to the garbage bin. "What are you doing?"

"Checking something. Give me those tweezers." The trash bin had remained open, and she had caught a familiar scent amid the nose-scrambling reek. Vse took the tweezers and reached into the bin. She took out a small, light book, still soaked in the unmistakable odors it had absorbed in the jeep. "This is the instruction manual from the jeep," she said.

"What's it doing here?" Tsiv asked.

"Good question." Vse took a delicate sniff. Yes, one certain odor was strong on it. "DuQuesne put it here."

"He did?" He leaned forward and sniffed. "So he did. But why?"

"I don't know," Vse said. "But I could have been killed without it when—"

The ground shook, cutting her off with the low rumble of a Marsquake. The quake was stronger than the earlier one, and Vse clutched at the bulkhead to keep from falling over. The shaking went on and on, and she heard the base creak and groan ominously. The noises persisted even after the Marsquake subsided.

Vse's phone rang. "Klou speaks," the old scientist said when she answered. "There's more trouble in the lab."

Vse hurried to the lab, and was nearly blinded by glare as she opened the door. Shading her eyes with her hand, she saw Klou bent over a work station. "What happened?" Tsiv asked from behind Vse.

"Not knowing, I can't say," Klou said. "The lights won't shut down and the temperature is rising."

Vse joined him and examined the computer display. "The readings make no sense," she said. "The quake must

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have deranged the computer." She touched the intercom button. "DuQuesne, Vse speaks. We have a computer problem in the lab."

"I know," he snapped back. "Don't waste my time. I'm busy."

Vse tapped commands into the keyboard. "I can't fix it," she said after a moment. It was already so hot that she was panting to keep cool. She winced as an overloaded light shattered, spraying part of the lab with quartz. "The computer won't accept my inputs, and any more heat will ruin the plants. Let's try manual control." She touched the switch which disconnected the computer.

"Manual controls will be finicky," Klou said, although he was already working with them. "Needing constant supervision, we'll have more work."

"It's steep ground ahead of us," Vse agreed. "But the computer should be fixed soon. I'll talk to Blake about it."

Vse went to the control cabin. Blake was already there, working at a keyboard. DuQuesne stood above him, and he glowered at Vse when he saw her. "What in hell did you do to the computer?" DuQuesne demanded. "You trashed the entire environmental control system!"

"I wasn't using the computer when the trouble started," Vse said. "Ask Tsiv. We were in the airlock. Then the earthquake hit and Klou called me—"

"That's not what the computer record says," DuQuesne said, "and I kinda believe it. You were using the computer when the system went down. Ignorant enough to call the computer a liar—hell." Shaking his head in disgust, he pushed past Vse and left the cabin before she could protest.

"You were in the air lock?" Blake asked quietly. "There's no work station there."

"I know," Vse said. "I used the one in the lab, but that was after the system crashed."

"Maybe the quake deranged the computer," Blake said. "It wasn't designed to take these rough rides. If there was a static discharge—could be. I'd better check the whole system."

"Can you fix the ECS software?" Vse asked him.

"I've already rebooted the system," Blake said. "It *should* be OK, but you might want to monitor the lab until I've given the computer a once-over. That'll take a few minutes."

Hearing that, Vse went back to the lab, where Tsiv and Klou fussed with the manual controls. Once the computer was back on-line Klou returned to his work, testing soil samples for renewed bacterial growth. Vse took Tsiv aside. "Do you think Khri had anything to do with this accident?" she asked him quietly.

"No," Tsiv said. "He would have to know as much about computers as humans, which isn't possible. I suppose Blake was right about a static charge, or whatever he called it."

"Yes." Vse had not truly believed Tsiv's story—until now. If he had been lying, she decided, he would have found some way to link Khri to the computer crash. Of course, a clever spy would know better than to overplay his hand. He might even know a way to get someone's scent on a piece of evidence without indicting himself. Who could say?

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And why had DuQuesne tossed out the manual? She realized that he must have sabotaged the power system, subtly damaging the cover plate to permit dust contamination. For murder? No, she thought. He hadn't placed her in an overly dangerous situation; perhaps he had only wanted to embarrass her, to wreck her future with the starship project.

A short while later, as Vse settled into her cabin to sleep, she wondered if she was getting paranoid.

"This is more than a practice walk," Vse said as she led Tsiv and Khri away from the outpost. She carried a set of sensors—seismometer, geophone, magnetometer and gravimeter—with instructions to plant them a mile from the outpost. The sensor spikes dangled from her belt kit. "The tidal strains rising rapidly, we're presented with a unique opportunity to study the Martian interior. The shock waves will reveal a great deal."

"Haven't the mumums done this sort of thing before?" Khri asked.

"Not recently," Vse said. "They once used small explosive charges to create shock waves, but Mercury's arrival is generating much more energy. We can learn more now."

"And they want us to plant their instruments for them," Tsiv grumbled. He clambered up a boulder and looked around. "Haven't we gone far enough?"

"No," Vse said, glancing at a readout in her helmet. They were only halfway to their goal. "The sensors have to be planted well away from the base, to prevent interference. It's too soon to turn back—"

Like a candle in a gale, the sun went out, plunging them into darkness.

"—but I can be persuaded to change my mind," Vse finished.

Their suit lights came on, casting pools of light on the ground. Vse saw that much of the sky was a starless black; the Nomadic power field worked by polarizing and absorbing all light, even starlight. An arc of normal space showed near the western horizon. "Interesting," Khri said idly. "Didn't the mumums say we had five or six hours before the sun went out?"

"We all make mistakes," Vse said. "Joseph, are you listening?"

"Right here," Blake said. "Something's gone wrong in a big way. You'd better head home."

"Belay that," DuQuesne said. "Carry out your orders. Or are you wankers scared of the dark?"

Vse hesitated. Ignoring a leader's wishes wasn't a highly regarded trait among kya. Even when justified, it seemed almost pathologically antisocial.

Vse exhaled in annoyance. Going ahead was crazy. "We're coming back," she said. "Khri, Tsiv, follow me."

DuQuesne's voice rumbled like an earthquake. "Are you disobeying a direct order to continue?"

"During an emergency I have the authority," Vse said.

"There is no emergency!" DuQuesne snapped.

"I disagree. Caution is always the best choice when the unusual happens in space." That quote came straight from the UN Space Agency's training

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manual.

"But we have our orders," Khri said. Human-hater or not, he was reluctant to disobey a leader. "We should go on."

"You have *my* orders," Vse said, and turned for the outpost.

The others followed her. As they walked a faint violet light appeared. Vse looked at the sky. Several near-parallel shafts of light glowed in the arc of unocculted space. Those were the laser beams from the power collector, working as rockets, slowing Mercury at a leisurely twentieth of a gravity. The glow came from soil, as robots stripped away Mercury's mantle and pushed the material into the lasers, to be flushed away into space by light pressure. Humans had built the system, but the Nomads had supplied the blueprints, and not even the people who did the engineering claimed to understand how it all worked. In its way, Vse thought, this restructuring of the solar system was as frightening as the extermination on Correy III.

The three kya returned to the outpost as quickly as the feeble light allowed. "Maybe you were right," Tsiv told Vse as the airlock cycled. "If it's so safe, let the mumums get their precious data themselves."

"Go inhale a tar pit," Vse told him.

"I think he has a point," Khri said quietly. They went into the ready room and started removing their suits. "If something happened to us out there, who would warn Kya about the dripmold?"

"There's Klou," Tsiv said.

"What if something happens to him, too?" Khri asked.

"I wish you'd air out that kind of talk," Vse grumbled.

"I don't know," Tsiv said. "Talking with Klou last night, he said it *could* have been a weapon. Being a scientist, he's too cautious to say Khri proved his point, but when a mind like Klou's says something is possible . . ." His voice trailed off suggestively.

Vse exhaled in exasperation. A lot of people would accept such pseudo-logic as proof of Khri's story—and, act or not, Tsiv's agreement with Khri irked her. "Being a scientist, I'm cautious too," Vse said. "I'll still come out and say this weapon talk is pure swamp gas." Her own foul language surprised her, but she went on, "Investigating, you would find no evidence of duplicity, but you *would* end up smelling silly."

"I hope you're right," Khri said. "If the mumums wanted to exterminate us, we couldn't stop them. I'd like to think we're safe."

You have to admire his effrontery, Vse thought as she left the ready room. She started to head for the lab, then changed her mind. DuQuesne would want to see her, and there was no point in delaying his inevitable explosion.

Both Blake and DuQuesne were in the control cabin. "Oh, it's *you*," DuQuesne said. "Did it ever occur to you that I *might* have a reason for the orders I give?"

"It did," Vse said. Out the corner of her eye, she saw Blake staring fixedly at his computer display, as though he would rather be anywhere else while DuQuesne dressed her down. "But I was within my rights to refuse that order."

DuQuesne threw up his hands. "Just

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what I need, a sidewalk lawyer. You idiot, we need the data those sensors would have given us. They could have given the main base a few seconds' warning before a really big quake hits."

Vse knew that was nonsense; there were already enough sensors spotted around Mars to let the base track any large shock waves. She also knew better than to say anything. DuQuesne would have loved to gig her for insubordination.

The communicator beeped rapidly. "Emergency communication from the base, sir," Blake said.

"I know what it is, fancy-boy." DuQuesne turned to the panel. "DuQuesne here. Go ahead, Tsiolkovskii."

Farouk al-Taif's dark face appeared in the display. "Commander, is all your staff present?"

"They're all inside. The kya just came in—"

"Good!" al-Taif said. "We were afraid they'd have scattered all over for training. We're evacuating Mars—if we can. Drop everything and come here at once."

"What in hell is wrong?" DuQuesne demanded. He looked angry at losing a chance to lambaste the kya.

"Mercury is *not* maneuvering into a high circular orbit," al-Taif said. "Our projections were wrong. Vector analysis says Mercury will pass within five thousand kilometers of the Martian surface. The tidal strains will be far greater than anticipated. Now hurry." The holographic image vanished.

Vse went to the lab, where Tumansky and Klou were checking soil conditions. "We're leaving," Vse said.

Klou let out an annoyed *gronk*. "The ecosystem being destablilized—" he began.

"I'm sorry, this is an emergency," Vse said. "Leave the computer in charge and go."

Tumansky stood, wiping dirt from his palms. "What's wrong, Vse? I know the power collector is on, but—"

"Mercury is on an unexpected course," she said. "Al-Taif says it will pass within five thousand kilometers of Mars."

"Ah," he said, and nodded to himself. "A tidal pump. *That's* why the Nomads arranged things that way. How brilliant!"

"A tidal pump?" Klou asked.

"Yes." Tumansky's eyes went wide in awe, but his voice remained calm and detached. "An elliptical orbit will cause maximum tidal strains. Those strains will pump energy into Mars. That will melt the core, the same way Jupiter keeps the interior of Io molten. Volcanoes should erupt, dumping gases into the atmosphere."

"You can't breathe volcanic gases," Klou said. "The human metabolism isn't *that* weird."

Tumansky chuckled. "We can bioengineer organisms to transform the air, Klou, or build microbots for the job. And the extra carbon dioxide will give us some greenhouse heating. *And*, if electric currents are established in the core, Mars will acquire a magnetic field."

Klou gave a curious sniff. "So Mars will be, what's that word, terraformed?"

"It's a first step toward terraformation," Tumansky said. "The tidal-pump theory was worked out years ago,

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but no one ever thought it would be possible to move a planet—"

"Will you two *move it?*" Vse demanded. Listening to them, she was irresistibly reminded of an old joke. Standing at the base of a mountain, a fellow looks up and sees a landslide; the entire mountain is falling atop him. He makes no move to escape. Searchers dig for his body, and are astonished to find him alive, if badly crushed. *Why didn't you run?* one rescuer asks. *Oh, I would have*, he answers, *but it was* such *a fascinating sight. . . .*

Klou looked bemused as he gave instructions to the computer. "I'll get him to a jeep," Tumansky promised Vse.

"Don't waste any time," Vse said. "DuQuesne being himself, I think he'd gladly leave us all behind."

Vse thought about going to her cabin, then decided there wasn't anything she needed to bring along. She went to the ready room, where Tsiv and Khri were getting into their suits. "DuQuesne ordered us to wear these things," Tsiv complained. "Why we need them for a simple ride—"

"It may not stay simple," Vse said. Through the bulkhead she heard the sandblast whine of a Martian storm. "I don't know how well the jeeps will handle this storm."

Klou and Tumansky entered the ready room. A moment later DuQuesne looked in from the air lock. "Where's Blake?" he asked.

"I don't know, sir," Tumansky said.

"Moron." He went to the intercom and punched its button. "Blake, get to the air lock, *now*."

"I still need a minute on the computer," Blake answered.

DuQuesne gritted his teeth, then stabbed a finger at Vse, who was nearest the ready room exit. "You. Go drag his ass back here."

Vse left, wondering if DuQuesne would chew her out if she didn't follow his order to the letter. The outpost shook and groaned as she entered the control cabin, where Blake sat at the computer. "Joseph, we have to leave now," she told him.

"It isn't safe yet," he said grimly.

"Meaning what?"

"Meaning the computer in the number two jeep has been sabotaged." He paused, bit his lower lip for a second, then picked up an unlabeled computer card. "I hope your nose is as good as I think it is. What do you smell?"

Vse took the card and sniffed it. She recognized the scents. "DuQuesne handled this. I brought it for him from Tsiolkovskii—"

"You *what?*"

"It was in a package that Kostamarova asked me to deliver. There's no mistaking the scent. Why? What's on it?"

"Several things." Blake typed a command into the computer. "The jeep is all right now. Let's go."

"What's the big stink about the card?" Vse asked as they hurried toward the ready room.

"It contains several programs. One let DuQuesne trash the ECS system. Another let him tamper with the records. That's how he made it look as though you caused the mess. And a third program would have caused a jeep to crash," he added, "*and* each damned program is self-erasing."

"To leave no evidence." Vse felt

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chilled; even after finding the manual in the trash, she had never imagined DuQuesne as a methodical, cold-blooded killer.

"Yeah." Blake's mouth set in a grim line. "The UN will make him wish we still execute people."

Vse gave him a curious sniff. He didn't sound like a technical advisor. "Who are you, really?"

"I'm an agent for Special Security Operations. We've identified some people—DuQuesne for one—who want to sabotage human-kya relations. I was sent here to watch him."

"And who else?" Vse asked. She recalled how surprised Kostamarova had seemed in her office when Vse had mentioned that the packet had contained computer cards. Guilty conscience, Vse decided.

"Kostamarova's involved," Blake said, confirming her thoughts. He looked at her as though searching for human expression on her face. "Why? Do you know something else?"

"I think I do," Vse said. "Remember my jeep accident? I'm certain DuQuesne damaged that dust seal. I *know* he tossed the jeep's instruction manual in the trash. I don't know what he intended."

"What he did means more than his intentions," Blake said as they came to the ready room door. Vse heard DuQuesne's bull voice grind out an order. "We'll have to talk later," Blake said.

Another spy, Vse thought as she climbed into her spacesuit. She wondered if she should mention this to Tsiv. What *was* the proper etiquette for introducing two spies? It wasn't the sort of situation that arose every day. . . .

As Vse entered the air lock garage she saw that DuQuesne had climbed into jeep number one. She thought about riding with him, to watch his actions during the trip. It would be interesting to see how he acted when jeep two didn't crash—

I *am* getting paranoid, Vse thought. She got into jeep number two with Klou and Blake. A moment later the air lock opened, and the jeeps slid into the dark and stormy Martian night. The headlamps showed nothing but swirling red dust as the computer drove the jeep. The gusting wind made for a rough ride, but Vse thought the computer seemed equal to the challenge.

"I should have ridden with Tumansky," Klou said. "Talking, I could learn more about this terraformation process."

"Use the radio," Blake said, and spoke to the air. "Jeep one, this is jeep two. Klou wants to talk with you, Vanya."

"Can the crap, jeep two," DuQuesne's voice answered. "Keep your eyes on the instruments. This storm is getting worse."

"Yes, sir," Blake said brightly. "It sure is bad, sir."

"Listen up, limp-wrist," DuQuesne growled. "Be careful over there. This is no time for an accident."

"Yes, sir, absolutely," Blake said. "Thank you for your concern, sir."

Vse rode on in silence. She would have liked to question Blake, but that was impossible in front of Klou. Besides, the computer might take the mention of DuQuesne's name for a command to radio him. Robot brains made even the most mundane piece of equip-

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ment unpredictable.

She wondered if she should talk to Blake and Tsiv together. It might be better if they cooperated . . . but Vse didn't know if they had a mutual goal, and she knew humans were rough on spies. She wouldn't want to get Tsiv into trouble.

Klou wanted to talk about the terraformation process. "It smells like the Nomads are going to a lot of trouble," he said. "I wonder if they'll expect extra payment for this?"

"I wouldn't put it past them," Blake said.

"I think this will benefit them," Vse said. Seeing Blake raise an eyebrow, she went on, "They're interested in boosting trade and industry. A century from now, maybe less, you'll have a colony world with a large population and more resources than Earth, and a power collector to supply almost unlimited energy."

"Which would make Mars a perfect world for industry." Blake nodded thoughtfully. "We'll profit, and we'll also be able to make anything they want, in any amount, at a reasonable price. Doing well while doing good—that's the Nomads all over."

A glow appeared ahead of the jeep and turned into the hazy outline of Tsiolkovskii Base's dome and airlocks. The jeep slowed and slid into the garage, and lights came on as the dust was removed. The jeeps opened up and their passengers climbed out.

Kostamarova was waiting in the ready room as the outpost staff filed through the door. "The evacuation has been delayed." she said. "The storm is getting worse. A shuttle can't land in this weather."

"So we could have skipped this little joyride," DuQuesne said.

"I think not." To Vse, Kostamarova's thin smile suggested she was not truly amused. "Mercury has disrupted the orbits of the Martian moons. Phobos will escape into solar orbit, but Deimos will impact in—" she checked her watch "—three hours and seven minutes. The shock wave will exceed the outpost's structural strength. The survival of Tsiolkovskii itself is problematical."

Tumansky said something in Russian; Kostamarova laughed nervously and answered in the same language. Then she switched back to English. "The observation satellites are maneuvering to maintain their orbits. We should have an excellent view as a flying mountain drops onto Mars."

"And it should be *such* a fascinating sight," Vse said. She removed her suit while the other kya snorted at the ancient punchline. "What should we do to prepare?"

"I'll want everyone in their suits before impact," Kostamarova said. "And familiarize yourself with the locations of emergency suits and repair kits, in case the impact causes us to spring a leak. DuQuesne, I'd like to see you in my office."

Blake and Tumansky left the ready room together. Vse hurried after them, hoping she could have a few private words with Blake before he got wrapped up with Tumansky.

Evidently Blake's thoughts traveled along the same line. "Vanya, why don't you see if you can find us a cabin?" he asked. "I think Vse wants to talk to

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me."

"I'll see what I can do," Tumansky said, and went down a corridor.

Vse led Blake into an enclosed computer work station. "You said some humans wanted to make trouble," she said.

He nodded. "There are some people involved in the starship project who want it to flop. Why, we don't know. They're not connected to any politicians or businessfolk; they seem to be operating on their own."

"Bigots?" Vse asked.

"I dunno," Blake said. "Their psych tests say they aren't bigoted—except for the Duke, whom Kostamarova recruited." He shook his head. "The more I learn the less I understand. Here's Kostamarova, delivering software which is meant for sabotage and murder. Yet she's worked on the starship project from the start, and she's praised all of the trainees."

"She shouldn't," Vse said. "Some of them are unfit."

"I've noticed that," Blake said, and sighed. "If I hadn't seen things for myself, I would have assumed that everything DuQuesne said was exaggerated and Kostamarova's positive reports were correct. But, damn it, there's nothing suspicious about glowing recommendations from qualified prople!"

"Unless . . ." Vse began.

" 'Unless' what?" Blake asked.

She looked at the computer panel, and thought of—what was the name of that arrogant know-all? Zheg, that was it, one of the first trainees. He had refused human help in learning how to use computers, insisting that he could teach himself by reading the manuals. Zheg had done it—he *was* a genius—but inevitably he had missed things not included in the manuals. He had run into several problems because of that ignorance.

"Imagine staffing a starship with a crew of—" Vse groped for words "—not idiots, not bunglers, but people whose personalities will lead to trouble."

"It would make the kya look bad," Blake said.

"And *that* would give your bigots and isolationists a weapon to use against interspecies cooperation."

"Right." Blake muttered an obscenity. "I can hear it now—why waste help on these aliens, let's do more profitable things with our resources, and all that. If someone said the trouble on the ship was a fluke, they could point to other incidents at the outpost—that ECS problem somersaults to mind. Your jeep-crash would have made another good example. Folks like Kostamarova would say that their glowing recommendations were the product of blind optimism, and they've had to lower their opinions of the kya, and so on."

Vse sniffed in agreement. What he said made sense. "Contrariwise," she said, "DuQuesne's criticisms would allow them to explain why qualified people were rejected. I have a hunch that you won't find any marks against the incompetent trainees."

Blake took a recording rod from his pocket and spoke a memo into it. "We'll check that, but I think you're right." He shook his head again. "Not that it would mean anything in court. Right now I don't have an airtight case. What's more, I'm claiming that Kosta-

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marova is working to harm the kya by praising you—which sounds like a paranoid fantasy."

There was no good reply to that. Vse said good-bye and left the work station cubicle. So Kya's isolationists and Earth's bigots were unknowingly aiding one another, she reflected. She doubted any of them would appreciate the irony. She also doubted their sanity. The Nomads had ruthlessly exterminated the people of Correy III for their uncooperative behavior. These people might bring the same fate down on their own worlds.

As she walked down a corridor she passed the ivy plant Chyo had grazed on—two days ago? she wondered. It seemed badly shrunken; several vines had been stripped of their leaves. Idly curious, and glad for a distraction, she went to the sick bay and found Doctor Gir.

"Everyone has been snacking on it. Running tests, I've found that ivy is safe," the little doctor told Vse when she asked him about it. Then he snorted in amusement. "Not that the safety saved Chyo from a pair of bellyaches last night."

"But you just said it's safe," Vse said.

"Not when you stuff yourself full of the leaves." Gir snorted again, then sobered. "Recovering in her cabin, a medbot is observing Chyo. But if you like, try a leaf. The flavor's pleasant."

"I think not," Vse said. She was *not* going to make a habit of nibbling on alien vegetation.

"Fine; that will leave more for the rest of us. I've spoken with Kostamarova about the possibility of importing ivy to Kya as a delicacy," Gir added. "Ivy being popular with the rest of the staff, I'm sure we could do a very good business."

"That's not a bad idea," Vse said. She shared the human opinion that good business led to good diplomacy. "But before you bring any ivy to Kya, I'd advise a careful study of the ecological effects."

Gir's muzzle wrinkled. "Why? Being a simple plant, ivy couldn't be a problem, could it?"

Vse snuffled at his ignorance. "Ask the computer about terran kudzu and tumbleweed. If—"

The sick bay quivered, and equipment and containers fell from shelves and benches, tumbling slowly in the low gravity. The lights flickered briefly, flickered again, then steadied as the quake ended.

"All hands," a female voice said in English. "Sensors report no damage. Please report any discrepancies in this report." The message repeated in Wideplain. Vse found it reassuring to know that there had been no damage—and that the humans were double-checking their instruments.

Vse spent the next half hour helping Gir tidy the sick bay. Nothing had broken, but the floor was cluttered with loose objects. As Vse had halfway expected, a second quake struck as she and Gir finished picking up.

"Sneeze on it," the doctor muttered after the quake ended. "These shelves aren't designed to keep things from falling. Being so, I'll just stack everything on the floor. You can run along now."

"Fine," Vse said. It had been a while since breakfast, and while she wasn't

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hungry enough to sample the ivy, the idea no longer seemed *that* unattractive.

She went to the base cafeteria. It was empty, and a glance at the wall clock told Vse the standard dinner break was an hour away. She didn't mind being alone; despite what DuQuesne thought, kya understood the virtues of solitude.

Vse picked at her food and wondered what she was supposed to do next. Tell Tsiv that Blake spied for the UN, and let him decide what step to take next? But that seemed unfair to Blake. Then again, the ease with which Blake and Tsiv had revealed their assignments to her suggested that secrecy wasn't all that vital to either of them.

"You seem pensive," Khri said as he entered the cafeteria. A chair formed itself into a comfortable stool as he sat down next to Vse. "Being so, you must be thinking weighty thoughts."

"I'm just tired," Vse said. "Working hard over the past several months, I haven't had much rest."

Khri's nostrils fluttered in sympathy. "Mars being in turmoil now, perhaps you will have time to rest."

"Perhaps." Vse wished he would go away. "But it's more likely I'll help to restructure the training program. Having had some unpleasant problems, we'll wish to prevent their recurrence."

"What problems?" Khri asked sharply.

"Oh, various things. Carelessness, sloppiness—I'm sure you've smelled a few strange things."

Khri sniffed. "Do you mean that dripmold mess?"

"That too, plus that stink with Chyo, and—" Vse stopped. She realized that Khri was pumping her for information. She told herself to shut up before she let something vital slip. "Feeling more tired than hungry, will you excuse me?"

"You'll need a place to sleep," Khri said as she got up to leave.

"I'll find a spot." Vse pushed her tray into the disposal slot and left the cafeteria. Unwilling to take a hint, Khri followed her. "I plan to rest while I can," Vse told him. "The quakes getting worse, there may not be much time later."

"Quite true," Khri agreed.

There was another quake then. Its intensity grew rapidly, and as the corridor lights flickered Vse felt herself falling over. For a second she felt a brief envy of the human balance-sense—she was willing to bet they could stay on their feet—and then something heavy slammed into her back. She fell to the deck and Khri clutched at her as they went sprawling. He held onto her, clumsily, and slipped as he tried to get up. His elbow bounced against the side of Vse's head—

Vse realized he wanted to kill her. She called for help as she twisted over and shoved her hands against his chest. The maneuver wouldn't have worked on Kya, but the Martian gravity made Khri light. He gronked in surprise as he flew up and away from Vse.

He recovered quickly. Khri tumbled to the deck, got up and ran at Vse. She moved out of his way, but he grabbed her cloak and momentum jerked her along with him. Vse ended atop him as they hit the metal floor. She swung a clumsy fist at his face, but Khri ducked the punch easily.

Then there were shouts and alien

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hands pulled them apart. Vse found herself held by a dark-brown woman with a fashionable crest of curly black hair atop her shaved head. "What's going on?" the woman asked Vse.

"Manure Breath just tried to kill me," Vse said.

"What!" Khri gronked. "You fell when the quake started. Hitting your head on the wall, you're mixed up—"

"Liar," Tsiv said. He seemed out of breath. "Coming in, I saw you tackle Vse." More members of the base staff came into the corridor. Tsiv turned to the nearest one. "Arresting Khri, do you have a cell I can borrow?"

Tsiolkovskii Base lacked a brig, but the sick bay had an isolation chamber and the designers had planned to let it double as a cell in case of trouble. Khri was quickly locked into the small room. "Just one question for now," Tsiv said to Khri's holographic image. He and Vse were alone in the sick bay. "Why did you attack Vse?"

Khri looked at the chamber's camera and exhaled in contempt. "I can answer that," Vse said. She spoke quietly. Gir had examined her and pronounced her fit, but her head ached from Khri's pummeling. "I talked too much. Fearing I knew the truth about the dripmold, he decided to silence me. Plus, I had already threatened to let the air out of his claim that humans created the mold. It wouldn't do to have a respected scientist disagree with him."

"Plausible," Tsiv mused. He looked at Khri's shimmering, scentless image. "And he would have claimed that you fell and broke your neck during the quake. A credible story if no one looked too closely."

"Humans might believe it," Vse said. "They know our balance-sense isn't good. He was following me, waiting for a quake to hit while we were alone." Khri's ears curled in rage, and Vse knew she had sniffed out the truth. "Tell me, Khri—why? Not the attack; why did you get involved in this plot?"

"Blackmail," he said. "Living a good life, I've run up debts. Threatening me with ruin, I was forced to cooperate—"

"Swamp gas." Tsiv spoke the obscenity in a precise tone which silenced Khri. The tone startled Vse; it suggested a personality far stronger than that implied by Tsiv's unassuming appearance. "You've gone beyond obeying blackmailers. Explain yourself."

Khri exhaled loudly. "You can't understand. Groundling!"

Tsiv's muzzle crinkled in puzzlement. "That's what pilots say," Vse told him. "It means someone who is scared of flying—"

Her words shattered Khri's restraint. "Groundlings!" the speaker buzzed with his shout. "Going to the outpost, I *flew!* I flew in a machine that didn't need a pilot, that maneuvered better than our best planes! It took me years to learn to fly that well, but these putrid mumums have robots that do *my job!* What's the use in being a pilot when—"

Vse switched off the intercom. Khri's image winked out. "He was afraid of becoming obsolete," Vse said quietly. "Obtaining human technology, we would no longer need pilots."

"It's more than that," Tsiv said. "Where's the prestige and glamour when anyone can fly? Most bigots are wrapped up in such concerns. They

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need to feel they're the best, the absolute herd leader, at *something*. Change would take that away from him."

"That sounds childish," Vse said. She felt bemused. It reminded her of what Tumansky had said about DuQuesne.

"It *is* childish," Tsiv said. "Children start out with certain basic fears. Aiding their survival, these are good. Fear of the unknown, of strangers, the dark, failing—these keep youngsters from wandering into harm. The fears stay with us, but as we grow we learn to use them, even enjoy them—there's always a bit of fear when you meet someone new, did you know that?"

Vse's muzzle twitched. "Well, yes . . ."

"Fear turned sideways is excitement. But some of us never change. Like children, we only feel safe with the familiar."

Kostamarova came into the sick bay then. "Tsiv," she said, "I hope you can explain what's going on?"

"I'm an overgovernment agent," Tsiv told her. "Khri has been involved in a plot to poison human-kya relations—"

Kostamarova's mouth dropped open, exposing sharp omnivore teeth. "*Him?* Can you prove this?"

"Well enough to have him extradited, under article ninety-six of the Earth-Kya Treaty. I'm afraid I can't be more specific," he continued apologetically. "The investigation isn't over yet."

Kostamarova hesitated. "Can you prove you're an agent? I'll need verification before I can hold Khri prisoner."

"My embassy on Earth can confirm who I am," Tsiv said.

"I'll call them," Kostamarova said. She hurried out of the sick bay.

Vse exhaled after Kostamarova had left. "What's wrong, scented one?" Tsiv asked.

Vse decided it was time to talk. "Blake is an agent for the UN," she said. "He says Kostamarova is involved in a plot of her own. I wonder if she thinks you're investigating her as well."

Tsiv considered that. "She must realize I don't have the authority to investigate humans," he said at last. "Vse, I'd like to know everything Blake told you. It smells like something the overgovernment should know."

Vse repeated her conversations with Blake. Tsiv had a number of questions, and she was describing the computer cards when her pocketphone rang. "Vse listens," she answered.

"Tumansky here. Have you seen Joseph? I can't find him anywhere, and he doesn't answer his phone."

"Doesn't the computer give his location?" Vse asked. One function of the base computer, she knew, was to track everyone in and around the installation.

"I've checked the machine," Tumansky answered, "but there's a glitch in it. It won't give me Joseph's location."

Vse felt apprehension. "Tsiv and I will meet you in the command center," she told Tumansky.

Tsiv followed her as she hurried out of the sick bay. "Do you smell trouble?" he asked.

"I don't trust glitches, not when Kostamarova and DuQuesne are around." They took the corridor to the base's cen-

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tral shaft, and climbed a spiral staircase to the command center. The door was sealed from the inside, and the electronic eye was dark. Nothing happened when Vse tapped the *open* button.

Tumansky came up the stairs. When the door refused to open for him he opened a panel and pulled a lanyard. The door slid aside and they went into the command center.

Blake lay crumpled on the floor of the circular room. Tumansky made a startled noise, then knelt at his side and turned him over. Blake groaned and tried to sit up, and Vse saw a purple blotch on the side of his normally pink face. "Take it easy," Tumansky said gently. "What happened?"

"DuQuesne whomped me up the side of the head." He touched the bruise and winced. "Feels like he used a sledgehammer."

"For God's sake! Why?"

"Tried to send a message to Earth . . . part of an investigation. Then they walked in on me, and the Duke—" He looked around. "Where are they?"

"Gone," Vse said. She could smell their scents—on a chair, at a panel, through a hatch—

She went to the emergency air lock, opened the hatch, and looked inside. "They went out," Vse said. "Two emergency suits are missing."

Tumansky got out his phone and called for a doctor. His face was tight with anger as he sat down at the computer. "I can't find DuQuesne or Kostamarova," he said after a moment. "The tracking function won't work."

"They must have sabotaged it," Vse said. She realized that Kostamarova would have her own sabotage programs. "The computer could track them outside, couldn't it?"

"It could—" Tumansky scowled at the keyboad. "*Chyort!* The computer just locked up."

"Lemme at it," Blake said. He staggered to his feet, and Vse helped him over to the work station. Tumansky gave him the seat and stood back while he worked. "They did something here," he said after a moment. "There's a new supervision program in here. Can't access it without the password."

"Just a minute." Vse bent her face to the keyboard and sniffed rapidly. The keys were covered with scents—Tumansky, Blake, several she didn't recognize . . . there! Kostamarova's scent was fresh and sharp. "Kostamarova used the 'enter' key and the numbers one, four, five, seven, nine and zero. Does that help?"

Blake shook his head and cringed at the movement. "I need to know the sequence she entered—"

"Try ten, zero-four, nineteen-fifty-seven," Tumansky said. "That's the date of the first satellite launch."

"A little bit of history, huh? Real easy to remember." Vse watched Blake enter the numbers. The holographic display blinked, changed, and changed again. Blake squinted and tried to focus his eyes on it. "Uh, oh," he said. He hit more keys.

The command center was plunged into blackness and the hiss of the air vents faded. Then dim blue emergency lights winked on and the air system came back to life. "Joseph," Tumansky said with quiet patience, "how

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many times have I warned you about playing with the pretty buttons?"

"I had to crash the computer," Blake said. "It was going to explode the fusion reactor."

"That's impossible!" Tumansky said. "The computer—"

"—was reprogrammed," Blake said. "Don't shout, Vanya, I've got a world-class headache. Kostamarova gave the computer new parameters for the fusor. The plasma pressure would have exceeded the reactor's maximum tolerance. The seismometers would have triggered it when they detected the next large Marsquake."

"Making it appear the shaking damaged the reactor," Vse concluded. That was clever, she mused—the plasma blast would have killed everyone, and the electromagnetic effects would have erased the computer memory. Kostamarova and DuQuesne would have had to concoct a plausible explanation for their survival, but Vse didn't doubt they had imagination equal to the task. "Could the reactor really explode like a bomb?" she asked.

"Not like a weapon," Tumansky said, as Blake shook his head weakly. "The fusor is built underneath the base. The plasma would have vented through the base on its way outside."

"Would that be bad?" Tsiv asked.

"Imagine standing in the exhaust plume of a fusion rocket," Tumansky said.

"At least now I have solid evidence against our fearless leaders," Blake said as a medical team came into the command center.

"So you do," Tumansky said. "Let's get you fixed up, and then you can tell me what the dickens you are talking about."

Tumansky watched while one of the team members took a stretcher from her pocket, expanded it, and helped Blake onto it. Then Farouk al-Taif came into the command center, and Tumansky and the two kya found themselves describing events to Kostamarova's second-in-command.

"I have to believe you," al-Taif said. Despite the low gravity the slim, dark man seemed to sag as he sat on one of the room's swivel chairs. "But—destroying the base! Why would she do that?"

Tsiv snorted sourly. "As your English say, dead men tell no tales."

"I know, and yet—has Kostamarova gone insane?" al-Taif asked.

"If she has, it's an improvement," Tumansky said. He tugged at his short beard, as though trying to pull ideas from it. "It won't take her long to realize the base hasn't been destroyed."

"Then we have to catch her and DuQuesne at once," Vse said. "Having tried to destroy the base once, they'll try again."

"Yes." Al-Taif scowled as he marshalled his thoughts. "We must guard the air locks, and when we reactivate the computer we must check it for more boobytraps—"

"Wait," Tsiv said. He leaned over and sniffed part of the work station. "Kostamarova put a card in this slot. Could it have carried her sabotage program?"

"It must have," Vse said. "Let's have it."

"The slot is empty," Tsiv said. "She must have taken the card."

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Al-Taif cursed in a language Vse didn't recognize. "There are external computer terminals. They could use them to reprogram the computer."

"Can you disconnect them?" Vse asked.

"No one ever thought that would be necessary," al-Taif said. "The engineers designed against accidents, carelessness—but not malice." He had balled his hands into fists in frustrated anger. "Worse, the computer can be reactivated through any terminal—the designers were concerned with flexibility, not idiot security!"

"We'll have to go out and catch them," Tsiv said.

"That shouldn't be too hard," Tumansky said. He sounded grimly pleased. "There aren't many external terminals. We'll guard them and seal the air locks. Those emergency suits don't carry much air; they'll have to surrender soon."

Al-Taif scowled. "I'm far from enthusiastic about wandering around now. The storm is dangerous enough, but Deimos will impact in an hour."

"Our friends may count on that," Vse said. "Having us pinned down, they can move freely. And if their air is limited, they'll have to act quickly."

"Yes," al-Taif said. He was silent for a brief moment, but Vse felt certain the time seemed much longer to him. "I'll get some people out there while we fix the computer," he said at last.

Vse gestured to Tsiv and Tumansky. "We should go, too."

They headed for the main airlock, while al-Taif issued orders over the intercom. Vse decided that the man had a methodical mind; he assigned names to different hatches and work stations, urged caution in facing the wind, advised carrying pipes and tools to use as weapons.

A half-dozen people were getting into suits in the ready room when Vse and the others entered it. "I don't know," Vse said. "Kostamarova must know al-Taif's mind; she can guess what he'll try now. And DuQuesne is, er . . ."

"Erratic," Tsiv said with a snort. "Just like that omnivore talk I belched at Khri."

"I don't know what they can do," Tumansky said. "They can't catch us unawares now."

Vse mulled that over as she suited up and waited to enter the airlock. DuQuesne was an experienced astronaut, and Kostamarova certainly knew all there was to know about the base. Both of them were ruthless and desperate, and they had more experience in chicanery than their opponents.

Vse passed through the air lock and stepped outside. Her suit lights came on in the dark, wrapping her in an ochre haze of blowing dust. She heard a grating whine through her helmet. The air was too thin for a proper wind-howl, but it blasted her with dust and sand. Vse took a few steps and decided that if she was careful she could avoid being blown over. She could see a short distance with her lights; the dust was not enough to completely obscure vision.

Static-thickened voices crackled in her helmet. Tumansky called out something cheerful in Russian, then switched to English. "Back home in Siberia, this is a mild summer breeze."

"I shall take your word for that," an oddly-accented voice said. "This sand,

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what might it do to faceplates?"

"The visors are etch-resistant," al-Taif said. "Get to your positions. If you become disoriented, notify me at once."

"Can you tell where our playmates are?" a female voice asked.

"Negative," al-Taif said. "They switched off their radios."

"Then we're even," Vse said. "They can't hear us." She looked at the haze around her. Where would she hide?

"Downwind," Tsiv said.

"Was I talking to myself?" Vse asked.

"Muttering, to be precise." A blur appeared in the haze and took on the shape of a spacesuited kya. "I'd get downwind and approach from that direction."

"Yes—no!" Vse said. That was kya thinking, done in terms of scent and wind. Humans thought in different terms. "They'll keep out of sight," Vse said. "Behind a ridge, in a gully—"

"There's a crevasse east of the main air lock," a voice said. "It's a fifteen-minute walk."

"What are you planning?" al-Taif asked.

"To upset their plans," Vse said. She checked her helmet display, and turned until the gyrocompass said she faced east. She began walking. She told herself that the crevasse made double sense as a hiding place. It would conceal the fugitives from any searchers, and it would shield them from the fusor's blast and radiation.

"Stay out of the crevasse," al-Taif ordered. "I cannot allow anyone to risk—"

"Kostamarova will be counting on that," Tumansky said. "Vse, turn south. I'll go north. We'll catch them between us."

Al-Taif uttered words which Vse found especially pungent. "Deimos impact is in forty-seven minutes. At least show enough sense to exit the crevasse before then."

Tsiv followed Vse into the crevasse. It was four times as deep as she was tall, and its bottom formed a sharp *V* of jagged red rock. The wind came in gusts rather than a steady blast, but Vse still could not move quickly in the narrow, rugged space. Worse, the crevasse did not follow a straight line, but zigged and zagged at random. She lost track of time. The crevasse walls blocked radio transmission, and she wondered if al-Taif was warning her about Deimos's impact.

And then an erect shape loomed over Vse. It hesitated in the swirling dust, as though shocked to see anyone, and then it lunged at her. The human slammed Vse's back against the crevasse wall, and Vse found herself visor-to-visor with Kostamarova. Her face twisted into a snarl, a contortion of sharp teeth, white-rimmed eyes and wrinkling hairless skin—

Vse fought off her shock and pushed Kostamarova away from her. Kostamarova staggered as she hit the crevasse wall, and for a second Vse thought the impact had stunned her. Then the woman clutched at an arm of her suit. Air fluttered through a gash cut by a jagged rock.

Vse's training took over. She took a patch from her belt kit and unwrapped it. Kostamarova held out her arm and

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Vse applied the patch, although she felt certain the truce would last just long enough to save Kostamarova's life.

Tsiv had taken a large patch from his own kit. While Vse sealed Kostamarova's arm Tsiv pressed the patch over her visor, blinding her. Vse heard him sniff in triumph as he reached out and pushed the radio button on Kostamarova's chest pack. "Climb the wall and call for help," Tsiv told her.

"I can't see," Kostamarova said. She sounded frightened. Her hands pawed at the patch, but the adhesive held tight.

"We'll help you," Vse said. She hoped that Kostamarova's fright was genuine, that it didn't mask a trick. Omnivores were deceptive—

Enough of that, she thought, and grasped Kostamarova's wrist. The woman let her and Tsiv guide her up the crevasse side. The wind seemed to grow in strength as they rose, as if it was seizing the chance to pluck them from the wall and smash them down.

They reached the top and al-Taif's voice roared in Vse's helmet. "—out of there! Hurry, you idiots! Impact in one minute!"

"We're coming," Vse said. The storm continued unabated, but she could see the glow of the base's lights through the dust. Evidently the computer and fusor were back on line.

"Name of Names," Tsiv said softly, "will you look at that?"

Vse looked where he pointed. A glow had appeared in the sky south of the base, growing swiftly in brightness. A line of white fire emerged from it and streaked across the sky, so intense that its light burned through the blanketing dust and cast sharp shadows. Streaks of fire veered away from the main body, leaving their own flaming trails as Deimos broke up. The burning moon vanished below the horizon, and seconds later there was a brilliant flash. Vse shielded her eyes with a gloved hand.

Her eyes watered as she blinked at the purple afterimages. "It really was such an interesting sight," she heard herself say.

"Be glad the horizon screened us from the full visual effect," al-Taif said. Then there was a sharp *boom*, attenuated by the Martian air. "That was only a sonic boom. The real shock wave will hit in fifteen minutes. Ejecta will arrive soon after."

"Take Kostamarova to the base," Vse told Tsiv. "I'll look for Tumansky."

"I'm over here," Tumansky said. "Get away from the crevasse. It may collapse when the shock wave hits."

"Did you find DuQuesne?" Vse asked him.

"No. I hope the wall falls on him. Al-Taif, how's Joseph?"

"Blake? The doctor says he has a minor concussion. He's—quick, south of you, I'm tracking DuQuesne now."

Vse peered through the blowing dust and saw an indistinct shape moving toward the base. Vse hurried after DuQuesne, although their bulky suits turned their race into a slow, clumsy parody of running. Within minutes she was gasping for breath, but she gained on DuQuesne and knew she would catch him before he reached the base. She heard al-Taif call orders to other people, methodically positioning them to inter-

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cept DuQuesne.

Vse caught up with the man first. She leaped and grasped his legs in an awkward hug as they went down. DuQuesne landed on his face, but twisted over on his side and reached for Vse. His thick, bulky suit made it impossible for him to bend enough to reach her, but his legs writhed powerfully. Hold on, Vse told herself. She only had to keep her grip on DuQuesne until help arrived.

Al-Taif's tone changed suddenly. "Shock wave in ten seconds," he said. "I think the best advice is 'hold on . . .' "

Vse was about to make a sardonic comment when she heard a rumble louder than any Marsquake. The ground heaved and flung her into the air, and DuQuesne was torn from her grasp. She knew she was tumbling; several times her suit lights flashed on the ground below her.

The blast lost strength and Vse skidded into the ground, jolting to a halt as she struck a boulder. She saw DuQuesne not far from her, a blurry figure which landed on its feet as the blast tailed off. Vse saw him turn toward the glow of the base lights. Half-dazed, Vse staggered to her feet and resumed the pursuit, but she knew DuQuesne would reach the base before she could catch him.

The blast had carried them closer to the base. Vse saw the main airlock ahead of her. The outer hatch was gone and blue emergency light glowed through the red dust. DuQuesne headed for it and Vse realized what he had in mind. "The jeeps," she said. "Al-Taif, there are computer terminals in the jeeps. The air lock door is down."

"I know," al-Taif said. "We can't get in there. Pressure failure."

"Where is everyone?" Vse asked.

"Scattered all over," al-Taif said. He paused and Vse knew he was checking the computer. "At least there are no casualties."

There will be in a minute, Vse thought. DuQuesne vanished through the gaping air lock before she could reach him. Vse followed him into the garage just in time to see him climb into a jeep and seal the bubble top. In the dim glow of the emergency lights Vse saw DuQuesne take a computer card from a suit pocket. He held the card in one hand while he pushed his helmet open with the other. Then he hesitated—and pitched forward on his face.

Vse hurried over to the jeep. Inside the bubble she saw DuQuesne slumped across the seats, dead, bloody foam flecking his lips and nostrils. The interior of the jeep was powdered with red dust. DuQuesne had taken a single breath after opening his helmet.

There was movement as someone came into the lock. "Is he dead?" the space-suited woman asked Vse.

"Quite."

"I see." She peered into the jeep, then turned away. "I wonder why he didn't notice the dust?"

"He was in a hurry, and it's hard to see in this light." Vse looked up at the ceiling. "The dust detector is damaged. He must have assumed that, the red light being off, everything was safe."

"Habit," the woman said. "It'll kill you every time."

Vse left the air lock. A couple of humans had picked up Kostamarova; her suit was leaking air around the patch, and her slack face had the blue tinge of

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hypoxia. Vse helped them carry Kostamarova through a secondary air lock and into the sick bay. They had to take an indirect route through the base; half of the complex had lost its air when the shock wave hit.

Tumansky was already in the sick bay, at Blake's bedside. The bed had extended a number of sensors and tubes as it monitored Blake's health, although Vse thought he seemed well enough. "I don't understand," Tumansky said to Vse as she helped a medical technician remove Kostamarova from her suit. "Did they go crazy?"

"DuQuesne and Kostamarova were involved in a conspiracy," Vse said. She watched the technician put an oxygen mask over Kostamarova's face. "Joseph can tell you more, but when they thought they would be exposed they decided to kill everyone here to cover themselves."

"They panicked?" Tumansky asked.

"Panic? Not entirely," Vse said. "Having that sabotage program on hand, mass murder was clearly a planned option."

"Of course—" Tumansky shook his head. "But—but—"

"How could they kill people they knew and worked with?" Vse concluded. "I don't know—"

"*Eezmenneekee*," Kostamarova muttered through her oxygen mask.

Tumansky spoke with her in Russian, then ended the brief conversation with an angry chopping gesture. "She says anyone who helps aliens is a traitor to Earth," he said.

"And to a bigot," Vse concluded, "it's proper to kill traitors."

"I am not a bigot," Kostamarova said. Her eyes glared above the mask. "Do any of you care what space *means?* Truths, mysteries, answers to questions still unknown! And you would waste it on these unworthy *things*, who see us as a source of *ivy!* They want us for luxuries, for wealth, not for our wisdom—"

Blake laughed, cutting her off. The laugh became a groan. "Don't worry, Vanya," he said, when Tumansky's hand gripped his shoulder. "It hurts when I don't laugh, too. Ego, isn't it, Kosta? We can only colonize a certain type of planet. We're nowhere near as powerful as the Nomads. And the kya won't even sit at our feet and treat us as wise elders. We can't look forward to a future where we dominate the galaxy."

Vse saw Kostamarova's hairless face darken. Vse realized that Kostamarova was upset; Blake had sniffed out the truth.

"Our future," Kostamarova said coldly. "You're betraying it. Yes, smile! But see if you smile fifty years from now, when aliens dominate us!"

"I think we can hold our own," Blake said. He grinned wickedly. "Especially now that you and your playmates are out of the game."

"Are we?" She smiled, baring sharp-edged teeth. "We can drag you traitors down with us. The UN will insist on an investigation. Think of the damage the scandal will cause."

"Scandal?" Vse's eyes widened in a look of slyness. "There being nothing to investigate, why should there be a scandal?"

"Vse—" Blake began.

Vse gave a cheerful snuffle. "Being good people, Kostamarova and her

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fiends—er, friends, have merely filed some excellent reports on the trainees," she said. "It will be a simple matter to decide which reports are, er, *overenthusiastic*, and which are accurate. Knowing the difference, the selection committee can make its decisions accordingly."

"*We* control the selection committee," Kostamarova said.

"And your secretary general controls the committee," Vse said. "Someone could persuade him to replace some of its members."

Kostamarova began to say something. Then her bed decided she was overexcited, and sprayed a tranquilizer into her. The pillow fluffed itself as her head settled onto it. She slept.

"She could still make trouble," Vse said thoughtfully. "Being fanatical, she and her accomplices might expose themselves to make trouble."

"A Pyrrhic victory," Blake said. "Sure. They could give an anonymous tip to a reporter, or something."

"You'd think that Correy III would have scared some sense into them," Tumansky said. "Not to mention Mercury." He gestured at the ceiling, as if to suggest the casual arrogance of Nomadic power.

Blake patted his hand. "I wish people were as sensible as you think, Vanya. Maybe there's a way to stop them, but right now I'm drawing a blank."

Tumansky chuckled suddenly. "Joseph! As a native Siberian, I know the *perfect* solution."

Vse's muzzle wrinkled. "What does Siberia have to do with anything?" she asked.

Blake had begun making the human *har-har-har*. He interrupted his feeble laughter with an effort. "Not Siberia," he said. "It isn't isolated enough. Maybe the UN could transfer them to the research station on Wells IV. They won't find any reporters there, and we can censor their private communications."

"They could talk once they came home," Vse said.

"It won't matter after a few years," Blake said. "As they say where you come from, scents and scandals get stale fast."

"Exactly," Tumansky said. He fingered Blake's beard. "And now I expect you to tell me about this spying business of yours."

Mercury had settled into a stable orbit around Mars; the Nomadic power field had shut down and the sun was no longer obscured. The dust storm still raged around the planet, but there were no longer any humans or kya on the surface to witness it. Vse floated in the *Integral*'s observation compartment, watching the planet while the ship prepared to jump for Earth. On the horizon, a plume of ash and smoke from Olympus Mons stained the sky.

A familiar, welcome scent grew strong in the air. "Hello, Tsiv." Vse spoke without looking away from the window.

" 'Hello,' nothing," he said. Tsiv floated up to her and waved a paper under her muzzle. "What's *this* about?"

Vse looked at the sheet. It was a letter she had written to the UN Space Agency, removing herself as a candidate for the starship crew. "The com-

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munications officer told me that mail transmissions were private," she complained.

"So I hear. Blake showed this to me."

"Spies everywhere," Vse muttered. "Tsiv, it's my business."

"Not when you're one of our best candidates," he said. "Then it's everyone's business. What *are* you doing?"

"I plan to stay on Earth for a while." She sniffed thoughtfully. How to explain? "Humans make me uneasy. Not liking that, I want to work the feeling out of me."

"So you're going to sit around and sniff your own breath until you become perfect?" Tsiv demanded.

"I wouldn't put it that way. After seeing how Kostamarova and DuQuesne acted—"

Tsiv cut her off with a sniff. "You saved Kostamarova's life when you patched her suit. Changing places, can you imagine her doing the same for you?"

"Well—no, but—"

"Why not take a few days to think it over?" Tsiv asked.

Vse closed her eyes and exhaled slowly. Certainly if she was good enough to be chosen, she owed it to society to go. She didn't like to seem wishy-washy . . . but she hadn't had the time to give this much thought, and she felt enough doubt to wonder if the decision was correct. "There's no rush," she said.

"Fair enough," Tsiv said. He settled down to watch Mars with her. After a few moments the *Integral* turned on its long axis. Its thrusters fired, and after a short countdown there was a moment of absolute darkness outside the window. Then the ship left transition space and a crescent Earth floated in the window.

The ship had just made a minor course correction when Blake floated into the observation compartment. "I just heard from the home office," he said to Tsiv. "They've rounded up Kostamarova's band of merry men, and the UN is shipping them to the research station on Herbert II."

"What's it like there?" Tsiv asked.

"Think of the Sahara desert, with bits of the Mojave thrown in to relieve the monotony." Blake smiled. "Maybe you could send Khri to keep them company."

"It would serve him right," Tsiv said. "Being loyal to his buddies, he still won't talk."

"That doesn't matter," Vse said. "I suppose there's a way to track down the dripmold cultures without his help."

Blake nodded. "We can find them, now that we know what to look for. We're also going to tighten up the decontamination procedures on our ships, and send a few, uh, 'agricultural consultants' to Kya, to show your folks how to handle the dripmold in case something goes wrong."

"So both plots have collapsed," Vse said.

"Yeah," Blake said. "We've been lucky."

"I don't feel lucky," Vse said, glancing at his bruised face. If she had brought Blake and Tsiv together as soon as she learned both were agents, they could have worked together. At the very least, Tsiv would not have casually told Kostamarova that he was investigating an unspecified plot. That had touched

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off the chain of events which had nearly ended in disaster. "Dithering so much, I'm responsible for what happened."

"Don't blame yourself," Blake said. "DuQuesne and Kostamarova were the guilty ones. It was just bad luck that people like Kostamarova got into a position of power."

"I'm surprised she got so far," Tsiv said. "I understand how she found a willing tool in DuQuesne, but other humans should have noticed what she is long ago."

"Kostamarova isn't a bigot in the classic sense," Blake said. "She and her cohorts have a high opinion of humanity—including an ability to tolerate differences—and they think of the good of the whole human race. That's what fooled us. We assumed that their open-mindedness would extend to non-humans."

"A natural mistake," Vse said.

"Maybe," Blake said. "But the psych tests should have tipped us off. They were inflexible, incapable of change. They didn't want to make room for something new in their world. Well, I hope you'll excuse me?"

He seemed a bit anxious, and Vse realized he was going to see Tumansky. That would explain his nerves; human or kya, it was bad form to keep a secret from a lover. "How are you getting along with Vanya now?" Vse asked. "Learning that you're a spy—"

"Investigator," Blake said. He sighed in the human expression of resignation. "Vanya thinks I'm a spy, too."

"I'm sorry if that caused a problem," Tsiv said.

"Not exactly a problem." Blake smiled slightly. "He thinks it's exciting to have a spy for a lover."

"I can understand that," Vse said, thinking of Tsiv. To her surprise the thought stirred an odd sense of empathy with the humans. She was still puzzling over it after Blake had left the *Integral*'s observation area.

Inflexible, Vse thought. Maybe there *was* a difference between her and people like Kostamarova. "I suppose we'll have human advisors on our starship," she said to Tsiv, who had been waiting in patient silence.

"Being a good idea, that seems likely," Tsiv said. "Does that mean you're still in the running?"

"Yes." She sniffed thoughtfully. "The more I think about it, the more humans seem a lot like us. I'd like to be there when we find something *really* alien."

"So would I," Tsiv said. "With a little luck, we might both get onto the first expedition."

"I'd like that," Vse said. ■

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the reference library

By Tom Easton

Orbital Resonance, John Barnes, TOR, $19.95, 214 pp.
Reefsong, Carol Severance, Ballantine/Del Rey, $4.99, 314 pp.
A World Lost, James B. Johnson, DAW, $4.50, 316 pp.
Halo, Tom Maddox, TOR, $18.95, 216 pp.
The Bradbury Chronicles, William F. Nolan and Martin H. Greenberg, eds., ROC, $19.95, 328 pp.
Starclimber: The Literary Adventures and Autobiography of Raymond Z. Gallun, with Dr. Jeffrey M. Elliot, Borgo Press (P.O. Box 2845, San Bernardino, CA 92406), $24.95 hb, $14.95 pb (+ $2 s&h per order), 168 pp.
The Work of Dean Ing, Scott Alan Burgess, Borgo Press (P.O. Box 2845, San Bernardino, CA 92406), $22.95 hb, $12.95 pb (+ $2 s&h per order), 82 pp.
The Work of George Zebrowski, 2nd ed., Jeffrey M. Elliot and Robert Reginald, Borgo Press (P.O. Box 2845, San Bernardino, CA 92406), $22.95 hb, $12.95 pb (+ $2 s&h per order), 118 pp.
The Work of Charles Beaumont, 2nd ed., William F. Nolan, Borgo Press (P.O. Box 2845, San Bernardino, CA 92406), $22.95 hb, $12.95 pb (+ $2 s&h per order), 118 pp.
Dance of the Planets, A.R.C. Science Simulation Software (P.O. Box 1974, Loveland, CO 80539), $195 (+ s&h).

Sometimes you are moved to send letters containing praise (thank you!), brickbats (ouch! and ugh!), or questions (generally along the lines of "Who wrote that great story about the purple eyeball in the sewer?"). If you enclose an SASE (a self-addressed, stamped envelope), you get an immediate (though usually brief) answer. I won't do extensive research for you, since that's what libraries and reference works are for, but if I do happen to know who wrote that story, I'll say so. If I don't know, I'll tell you that too. (I'll warn you now that I have not read everything in the field, and that for what I have read my

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memory is not nearly as encyclopedic as you wish it were.)

If you don't enclose an SASE, you don't get an answer, unless you have managed to make a comment or ask a question that makes me downright eager to write a letter, as did Clyde Wilkes, who is now working on a biography of Simon Templar, the Saint (as has been done for Sherlock Holmes and Nero Wolfe, among others).[1] The reason for not answering is simple, and it's not that you send so many letters that springing for the postage will bankrupt me. Money's a factor, of course, but time is a more important one; answering all letters at length would cut seriously into my writing and other time. Getting picky about SASE's is my way of drawing a line. And every few years I feel obliged to use a little of this column to say so.

I'm not alone. Every writer I know or have heard speak on the topic says much the same thing: You be polite and provide the SASE, and I'll be polite and write back. Editors, of course, take the same tack toward us writers: They won't send our rejected stories back to us unless *we* provide that famous SASE.

You can write to me (and other *Analog* writers) care of this magazine. Or you can write to me (but not *them!)* at my home: Tom Easton, Box 805, RFD 2, Belfast, ME 04915. Enclose that SASE if you want an answer.

John Barnes's last novel was the thought-provoking *Sin of Origin*, which garnered considerable praise here and elsewhere. Now he gives us **Orbital Resonance,** a very different sort of story but still satisfying and quite open-ended.

The time is the next century. Earth has been laid to waste by mutated AIDS (a very real possibility that should scare the socks off you), war, and ecodisaster. The remaining cities have been domed. Savages roam the ruins outside the domes. Industry is moving into space, aboard habitats and satellites and reconstructed asteroids such as the *Flying Dutchman*, which swings in a power-assisted orbit back and forth between Earth and Mars. The corporation that has built and crewed the *Dutchman* has also taken it upon itself to decide what sort of crew the ship will need in the future, and then to educate and condition the present crew's children accordingly.

When the story opens, Melpomene Murray, teenager, student of a curriculum so challenging that it must horrify most modern American parents (and teenagers) while delighting the few who will ever amount to much, is beginning to write the book as a report on the recent past. The central event will apparently be whatever drove all adults to depart, leaving the ship in the youngsters' hands.

Are those hands too young? Perhaps not, for the youngsters were born and bred in space, they know the peculiarities of their environment far better than any Earth-bred adults, and they are very well educated indeed. At the same time, their shaping has made them intensely cooperative, oriented toward the welfare of the group and the ship, given to consensus decision-making, able to be quite puzzled by the very thought of putting someone in a cushy job just because they're a friend. They are also ferociously elitist, made so by strong competition in school and out.

Do you recognize a few touches of Heinlein there? You should. Like him, Barnes places competence high on the

[1]If that idea turns you on, I'll be happy to put you in touch with Wilkes.

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list of human virtues. Unlike Heinlein, however, Barnes does not glorify individualism. That, he says, is what ruined Earth. A sense of group solidarity and interdependence—not quite a group consciousness—is essential in space. Yet decisions must be made, sometimes far more quickly than consensus can manage.

Melpomene is something of a misfit. So is her brother, Tom. So is the class bully, Randy, until a new boy from Earth arrives to out-bully him. Mel and Randy get together, even becoming sweethearts. They discover clues that point to the conditioning the older generation has imposed on them, and then they discover that they, and Tom, comprise a "Special Category."

What is so special about them? Well, they don't become part of the group very well. They see things differently. Life seems to conspire to frustrate them. For more than that, you have the clues I've planted and my recommendation to buy and read this book.

Orbital Resonance is hardly "politically correct" in the void-sprach of the moment. It puts far too much emphasis on competence, competition, cooperation, and strenuous education for that. To my mind, this emphasis is more crucial now than it was when Heinlein wrote, for instance, *Podkayne of Mars*. The book is thus worth reading for that alone. But the book works well as entertainment too; it's a well structured coming-of-age tale with a very likable heroine, a number of other well drawn characters, a fairly plausible background, and bits of vigorous action. There's even some sex, though these teens are almost as shy and innocent as kids supposedly were in the 1950s.

The story's weakest point may be its date. It is set in 2025, and while plague and war and ecodisaster all fit well into that timeframe, I have my doubts that we can have that great a presence in space that soon. I also doubt that we will see Earth's Great Die-Off as early as the mid-nineties. But those are mere quibbles. Go. Read. Enjoy.

At the beginning of **Reefsong,** Carol Severance asks us to accept that the drug barons have reorganized as "World Life," used their immense wealth to buy up virtually all public and private land on Earth, and to support the anti-abortion, anti-birth control, anti-population control movement. Their mission, under a UN mandate, is to produce the food needed by a world population that is burgeoning out of control. Their goal, of course, has nothing to do with humanitarian ends; they want more wealth, more power, more control, more and more without end. They are corrupt, unprincipled, manipulative.

I don't have much trouble believing that they would if they could. It's the "could" that stops me, along with its obeisance to the conspiracy theory of history. Yet Severance didn't let me stay stopped for long; she doesn't dwell on the background; she states it as premise and moves quickly onward, with considerable verve.

Meet Angie Dinsman, a UN troubleshooter taking a break from her world-ranging duties. She is currently a firewarden in the mountain preserve that once held the ranch of her childhood. She has an assistant and lover, a World Life man, who is urging her to accept the company's inducements to go to the waterworld Lesaat, where algae farmers produce an enzyme that lets Earth's hordes produce some of the eight essential amino acids from starch. Rumor has it that a "total conversion" enzyme that can produce all eight has been found, but the research records are lost. An ace

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troubleshooter is sorely needed. "No way," says Angie. But then a forest fire arises, she is badly burned, and she awakens in a company medical lab to learn that her lover said she would love to go to Lesaat. She has been fitted with gills and hands with tentaclelike fingers. She owes the company a huge sum for saving her life and being modified. If she won't cooperate, she will be a slave for the rest of her life.

In the same lab, meet Pau. She's just a kid from Lesaat whose parents modified her genetically to have hands just like Angie's—indeed, Angie's hands *are* hers, cloned or . . . Her parents are also the inventors of the TC enzyme. They are also dead; the company brought Pau to Earth because kids are allowed on Lesaat only with their kin (it doesn't want any native-borns agitating for independence or other rights), it wanted to pump her for information about the enzyme, and it wanted the secret of her hands.

Angie resists the situation at first but soon agrees to go to Lesaat if she can take Pau with her. Once there she discovers a culture growing from odd scraps of Polynesian tradition, company moves that seem designed to eradicate all vestiges of local control or independence, and a natural environment in which she comes to feel at home. Here we find Severance at her best, even lyrical at times, for she is familiar with and loves the South Pacific—she lives in Hawaii and has "assisted in anthropological fieldwork in the remote coral atolls of Truk, Micronesia"—its people and their customs, the landforms, and the varied lifeforms in its waters. As Angie becomes accepted by and identifies with the locals, the reader comes to feel as at home on Lesaat as she. Her eventual victory over the forces of evil is thus quite satisfying.

If Severance can get away from such B-movie cliches as monolithic, mustache-twirling evil, she will produce some marvelous stories. On the other hand, she is very readable right now. In fact, I enjoyed *Reefsong* so much that I will refrain from picking on a number of minor quibbles.

James B. Johnson's **A World Lost** begins when spacer and peanut butter freak Rusty discovers his home world—and star—missing, along with family, friends, and fiancee. That world, Roanoke, is a recent colony of only 50,000 people, and the galaxy contains an immensely larger number, but Rusty is understandably upset. With the aid of his trusty and artificially intelligent spaceship Betsy, he is promptly off to ask questions of a tangled galactic bureaucracy and discover webs of concealment, a lady with her own investigational agenda, signs that humanity is withdrawing from the stars even though spaceships have been almost entirely replaced by matter transmission, a missing navy, and hints that the first-ever alien message has been received. Eventually, of course, Rusty finds out what happened to Roanoke and why, answers all his other questions, and gets the right girl. Along the way, Johnson shows us a familiar sort of galactic civilization and makes a number of vigorous — though standardized—satirical pokes at bureaucrats, ayatollahs, countrified mavericks, journalists, entrepreneurs, and more.

It's breezy and fast and a pleasant evening's read that doesn't pretend to add anything to the field. Unfortunately, it's also sloppy in a way that just may totally destroy any respect you may feel for the writer and his story. If you are at all technically sensitive, you will come to page 35 and the line, "a planet

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a few hundred thousand miles in circumference," and stop dead long enough to find a reference book and a calculator. You will note that this planet's surface gravity seems to be a standard one gee. You will then plug some numbers into the gravitation equation and find that the planet has to have a density on the order of one twentieth that of water, or about that of the head on a mug of beer.

You will sigh. You will shake your head. Perhaps you will wonder if this is a sly dig at the frothiness of a certain kind of SF or at the air-headedness of bureaucrats. You will decide that it's hardly worth noticing that the author seems to think the metric system will vanish in the face of America's parochial preference for miles. And you will turn the page.

Tom Maddox's first novel, **Halo,** has good points, but not enough of them. It is set in a twenty-first century when people can plug themselves into their computers with either brain sockets or egglike computer-controlled environments. People also carry artificially intelligent "memex" computers that develop identity and present themselves to each other, in their internal virtual reality, in human form. And the space station Halo, a classic wheel, is controlled by Aleph, an artificial intelligence that regards the station as its body. People do not know just how human their machnes have become. Aleph thinks of an unnamed woman with something akin to worship: "I do not know what I am," it thinks, "but know *that I am* and *that I am her creation.*"

Enter Mikhail Gonzalez, the narrator (too passive to be a hero). He is a data analyst for a heartless major multinational corporation, SenTrax, just returned from an Asian mission that nearly killed him. His and his boss' memexes decide that he's moping a bit much and needs a new assignment. Shortly after that, the boss tells him to head for Halo, where an attempt will be made to give a paralyzed man, Jerry Chapman, a new reality inside Aleph. To give him the best possible chance of survival, SenTrax has reengaged Diana Heywood, a woman who once worked with Chapman and Aleph on another project. Gonzalez is to look over their shoulders and out for SenTrax interests.

So much for the first quarter of the book. You now know who Aleph's goddess has to be. You know the questions the rest of the story must answer. Unfortunately, you also know so many of the answers that the pages of New Age waffle-gab—a bit of Zen, a few wild talents—a little later on become intolerable padding.

Or maybe we've just seen too many stories lately in which the ghost in the machine comes alive.

In honor of the fiftieth anniversary of Ray Bradbury's debut as a writer, William F. Nolan and Martin H. Greenberg have produced **The Bradbury Chronicles.** It is an anthology of "Stories in Honor of Ray Bradbury" by 21 writers who love him and his work, treasure his effect on their youth, and feel a debt to his influence on their writing careers; there are also a hitherto unpublished story and an afterword by Bradbury himself, and appreciative introductions by Nolan and Isaac Asimov.

The contributors include Ed Gorman, Charles L. Grant, both Richard Mathesons (father and son), Charles and Christopher Beaumont (again father and son), Chelsea Quinn Yarbro, Gregory Benford, J. N. Williamson, F. Paul Wilson, Robert Sheckley, and Orson Scott Card. Most of the stories pick up

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on characters (e.g., Uncle Einar), settings (Mars, of course), and scenes from Bradbury's own stories. Many manage to sound rather like Bradbury, both in language and in their handling of sentiment. A few are so strong that they need not depend at all on the Bradbury connection for their publishability. Indeed, one of them—Orson Scott Card's "Feed the Baby of Love," which concerns a famous singer who leaves her wealth to dwell incognito among the people and rediscover her soul—may well be an award contender.

Card's story is easily the most successful entry in this volume, but that is not to say that the book holds no others that will please you. It does, and the package will please you all the more if you too remember Bradbury fondly and wish to revisit him and remember some of his most famous works.

Forty years ago, he says, someone called him "the idea man of science fiction." If you want to know why, get a copy of Borgo Press' **Starclimber: The Literary Adventures and Autobiography of Raymond Z. Gallun,** with Dr. Jeffrey M. Elliot. Born in 1911 and a prolific contributor to the magazines (including *Astounding*) from 1929 until the mid-fifties (with a recent return to *Analog*), Gallun (pronounced "Galoon") was one of the very first to ask many variants of the basic "What if?" question of SF. In *Starclimber,* he reveals an inquiring mind nurtured in an offbeat rural Wisconsin house, early attempts at writing, and prompt success in the years of the Great Depression, when SF was one of the few sources of the optimism in short supply elsewhere. Later he became a globetrotter, visiting Mexico early on and residing in Paris on the eve of World War II, where he taught English to refugees on their way to England, Australia, and the States. This section of his tale I found interesting for the light it cast on what has to be regarded as the central historical event of this century.

The rest has a narrower appeal, for it concerns the developing mind and talent of a science fiction writer in the dawn days of the field. If you have read other writers' (e.g., Asimov's, Pohl's, and Williamson's) accounts of the same period, you will have noted a certain clubbishness. Gallun, though he met many other SF writers, never really joined the club. He seems to have been more interested in bumming around, working in canneries and the like to pay his few bills, writing only when he was settled down between excursions. Since he wasn't a member of the groups that often, in effect, promoted their members' work, when he stopped writing SF in the fifties (going into technical writing), few seemed to notice his absence. He vanished so thoroughly that when he returned to SF in the seventies, his past contributions were long forgotten. Still, while he wrote SF, he was a productive writer; the book's index lists 109 short pieces and 6 novels; 3 of the shorts appeared in 1977, 1980, and 1989; 3 of the novels came out in 1974, 1981, and 1985.

What does the "with Dr. Jeffrey M. Elliot" on the author line mean? Often that phrasing indicates a ghost writer. Here, I suspect, we see a variant of what Elliot is already well known for, the in-depth interview. Perhaps it began with Gallun's own written-out or taped reminiscences, and grew as Elliot drew the man out. Perhaps it is really an extensive interview presented in autobiographical format. Perhaps Elliot only edited. Whatever, the book's tale is smooth and lucid, with Gallun's voice coming through as if he were talking

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to you and you alone of his successes, frustrations, and intriguing interludes.

Borgo Press has also just released three "Annotated Bibliographies and Guides." The first is **The Work of Dean Ing,** assembled and introduced by Scott Alan Burgess. Ing may be of special interest to *Analog* readers because he began his writing career here ("Tight Squeeze," February 1955), dropped out of SF for 20 years, and came back as a best-selling novelist with a strong eye to getting messages across. In the Borgo Guide pattern, there is an essay ("Excuse the Shouting . . . ") in which Ing discusses his work and attitudes.

The other two Guides are new editions, revised and updated, of **The Work of George Zebrowski,** by Jeffrey M. Elliot and Robert Reginald, and **The Work of Charles Beaumont,** by William F. Nolan. You know Zebrowski as the author of a number of distinctive and thought-provoking novels (*Macrolife, The Omega Point, Stranger Suns*) and the editor of the *Synergy* and other anthology series. Beaumont was a seminal figure in the field, though he did much of his work writing for the old "Twilight Zone" TV show. He died in 1967, aged 38 years, of Alzheimer's disease.

Collectors, scholars, and libraries need all three.

Not long ago, I saw an ad for **Dance of the Planets: Space Travel for the Inquiring Mind,** a software package that simulates the Solar System. Since I have lately taken to tossing the occasional software review into this column, if the software might reasonably be expected to appeal to SF readers, I wrote to A.R.C. Science Simulation Software and asked for a review copy. They promptly sent one, and now I can tell you that even though it doesn't really live up to its "Space travel for the inquiring mind" subtitle, if you would like to:

—Watch solar and lunar eclipses from any point on the Earth's surface

—See what stars, planets, or galaxies are visible from any Earthly location on any date between 4680 B.C. and 10,000 A.D.

—Follow the appearance of Saturn as it changes year by year

—Look at the Solar System from outside

—Track comets

—See even the smallest, most recently discovered moons and their orbits (even in three dimensions, with the red lens/blue lens glasses provided)

—Study orbital interactions and satellite captures

—Run things in reverse or fast-forward

—Print what you see

—And much, much more!

Then this is just the thing for you. It is, indeed, the closest thing to having a combination time machine and spaceship, and it deserves the high praise it has received from reviewers in *Scientific American, Astronomy, Sky & Telescope,* and *PC Magazine.*

Science fiction readers (and writers) can use it to check planetary arrangements and plot logistics. Amateur astronomers can get help for pointing their telescopes in the right direction to see virtually anything within the Solar System and many galaxies and other objects beyond. It will draw and label the constellations for you. It will even teach you a good deal of astronomy in a uniquely hands-on way, for the manual covers the astronomical phenomena the program simulates, and spells out what to do with the program to see numerous illuminating examples. It is thus a grand

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educational device.

What do you need to run it? Any old IBM-compatible computer won't do. You need an 80286, 386, or 486 machine, DOS 3.0 or better, and EGA or VGA graphics. A hard disk helps, and if you don't have a math co-processor chip in your machine, expect to wait for the program to compute views. On the other hand, I don't have that chip and I did find the waits tolerable, albeit sometimes barely so.

Are there shortcomings? It's limited to the local Solar System, for one thing. You can't get very close to planets and moons, so you can't see much detail, although that detail is often better—e.g., Saturn's rings—than what you can get with a good telescope). You can't see the backside of the Moon. Distant galaxies are just grey disks at all magnifications. Moving through the Solar System requires jumping from scene to menu and back, so there's no sense of flying or driving. And if you would like to track a spacecraft such as Galileo, you're out of luck although there is a way to insert new items with neatly periodic orbits, such as asteroids and comets.

But what the heck. In a few more years, we'll have gigabyte computers that make present technology look like kiddy toys. Then A.R.C. will be able to give us—or even surpass—nature's own level of realism. For now, they've done about as good a job as anyone could ask. ■

●The scientist has a lot of experience with ignorance and doubt and uncertainty, and this experience is of very great importance . . . in order to progress we must recognize our ignorance and leave room for doubt. Scientific knowledge is a body of statements of varying degrees of certainty—some most unsure, some nearly sure, but none *absolutely* certain.

Richard P. Feynman

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brass tacks

Dear Stan:

I recently received my July issue of *Analog* and I was quite pleased. I'd like to make a few comments. I enjoyed the science fact article. I say "Great. Let's do it." However, I don't think the congresscritters will go for it. In fact, I'd say the chance was exactly equal to the number of sentient life forms in Congress, i.e., 0. I've come to the conclusion that every single one of the problems with this country in general, and the space program in particular, comes from short-term thinking—and long-term thinking is in very short supply in Washington. Representatives think "long term" means anything over 18 months. Senators think it means 5½ years. I have an idea. Why not make up a bunch of copies of "Turkey Day" and mail one to each congressman? Maybe a few of them will get the point.

On more pleasant matters, I was pleased, and in one case surprised, at the fiction in the July issue. The surprise came from "The Cold Solution." I read the story "The Cold Equations" in *The Science Fiction Hall of Fame Vol I*—once. I will never read it again, not because it was bad, far from it, but because it affected me so deeply. It affected me deeply enough that I tried to write a counter story myself. One with the same basic problem yet with a happier ending. I came up with several possible solutions but none of them were strong enough to make a story out of. Now along comes Don Sakers. In his story he addressed all of my "solutions" and found reasons to discard them. Then he found an alternate solution, one I had never even considered. So, thank you Don Sakers, for finally laying to rest one of my own ghosts.

While I enjoyed "The Cold Solution" immensely, there were two prob-

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lems, however. One problem it had in common with the source story: I find it difficult to accept that the spaceship could be *that* weight critical. When the empty mass of the ship is considered, thirty kilos means a go/no go decision? Still, it is the basic premise, so I can let it slide. The other was the idea of dumping air. Sakers said they could lose a kilo or two that way. Under standard temperature and pressure, 1 cubic meter of air masses 1.29 kilograms. While they may not have had 25 cubic meters to dump, I think Diane should have given more consideration to that option. It still might not have been enough, but only 1 kilogram? Oh well, those are distinctly minor points in an otherwise excellent story.

"Distant Tigers" was another good story. It seems to parallel one of my own views: The current space program compares to the Lewis and Clark expedition. We need now for the Conestogas to roll. I would have liked to see it done without the "magic" antigravity gizmo (A Dean Drive maybe?) but I don't really see how it could, so I can't complain.

And last, at least for this letter, "Ode to Joy." This is the kind of story I wish I could see more of: one that leaves you feeling good in the end. I don't know enough physics to know if the radiation canceling gimmick is plausible, but then the story was good enough that I don't care.

DAVID BURKHEAD

Dear Stan:

While "The Cold Solution" by Don Sakers does address the story problem of Tom Godwin's "The Cold Equations," and does offer a solution of sorts (and according to James Gunn, Campbell was inundated with solution letters after the original appeared, though apparently he didn't choose to publish any), it doesn't address the crucial flaws of the original, and it creates a few of its own.

To me, there are two primary flaws in "Equations," flaws that might have been fixed somehow had Campbell insisted on another rewrite. (Reliable sources* say that Campbell had already requested one rewrite because a first version had the pilot figuring out a way to *save* the stowaway.)

First, the only thing keeping potential stowaways out of the emergency ship is a sign on the door. No lock, no guard, no warning siren when the door is opened by unauthorized personnel. This, on a passenger ship. I'm sure the captain of any ocean liner would point out that passengers can't be trusted to keep out of forbidden areas. Especially if the trip is a long one, leaving them with lots of free time.

Second, in his pre-flight checkout, the pilot obviously didn't look into the supplies closet to make sure the supplies were really there. If the only things on board the ship are the materials absolutely necessary to his continued existence and to the success of his mission—none of which can be jettisoned—then his life and his mission could depend on his checking that closet, and he'd be incompetent not to. Of course, he would then find the stowaway before leaving the mother ship. . . .

The new story retains those problems and adds two of its own. First, if all Space Force cadets read "Equations" at the Academy, why didn't this one learn a lesson from the story and check that closet? You'd think that would be automatic, almost a superstition among them. And second, while I agree that laser-knifing off a few limbs is an inge-

*including Jim Gunn

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nious solution, I can't help wondering how the pilot manages to land the ship while in shock and agony, and probably even unconscious, from having cut off her own legs. I didn't see anything in the story that indicated she had some way to block out the pain, nor anything to show that the computer could land the ship while she was unconscious.

In spite of its problems, the Godwin story has a substantial emotional impact when you first read it. And that's because it doesn't have a happy ending, which I presume was Campbell's intent. But I teach it in a writing course, and my students always wind up picking it apart. It could have been so much better.

And I've always wondered about all those readers' solutions. They must be somewhere among Campbell's letters . . .

PHYLLIS EISENSTEIN

Dear Dr. Schmidt:

I was irritated to read in G. Harry Stine's July Alternate View an example of "what everybody knew" of what wasn't so.

He claims that in the 1940s, all radar operators *knew* that if you threw up a steel wool ball in front of the outlet before the radar dish, it would be vaporized. Well, maybe the operators knew that, but then they never were the clever knowledgeable people who instead became radar mechanics.

Radar mechanics had to get up in front of the dish of 3,000 kilocycle units, as it was then, kilohertz as it would be now, and clean the damn things and the tube that fed the energy to the screens down below. And in the 1940s, when you had to do that, you didn't switch off the power—it would have enabled the enemy to sneak through undetected.

Furthermore, what was well known, in just the same fashion, was that if you could talk the women into spending a short while up in front of the dish, it would allow the men to enjoy a good night out, said female being willing. (And don't jump to conclusions, I was one of said female mechanics, myself!) The rumor was that it made one temporarily sterile. In fact, it used to be wondered whether it affected males the same way, though no enterprising female ever carried out detailed studies on this, as far as I know.

All that was felt, in front of the dish, when you placed your hand in front of the collecting point, was a slight warmth. You did not, however, leave your hand there for long as it was believed it would become cooked.

And how true that was!

However, steel wool had nothing to do with the invention of microwave cookers, although the warmth might have been. And while it is possible that steel wool, being metallic, might have vaporized, to have placed it between the dish and the collecting point of the tube must have been tolerably difficult, the tube entrance actually facing the dish, and not the other way.

My radar station was in Devon, right by the home of the D'Oyley Cartes, and I can recall often the superb blossoms that grew along the cliffsides there in spring.

But no, I don't recall ever seeing steel wool vaporized, not even at radar training school.

JOY K. SANDERSON

No. Lindenhurst, NY

The author replies . . .

Dear Stan:

I'm sorry that Joy K. Sanderson was irritated by my statement in the July 1991 *"Alternate View"* column concerning the vaporization of a ball of

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steel wool when thrown up into a high-power radar set's beam.

As a member of the Colorado Air National Guard in 1947, I was trained as a radar operator on the SCR-521 and SCR-584 radar systems. I saw the steel wool vaporization trick in my training. Later in the 1955-1957 time period at White Sands Proving Ground, I saw it done again with the SCR-584 radars at C Station, and with the SPG-49 Talos tracking radar at the *U.S.S. Desert Ship* of the U.S. Naval Ordnance Missile Test Facility where I was operations engineer.

I didn't know about the rumor that exposure to radar radiation made people sterile. No one ever noticed a trend at White Sands where normal births were far in excess of those in nearby Las Cruces and El Paso. But, of course, there wasn't much to do at White Sands in the evening. . . .

Ms. Sanderson missed the point. She also missed being the inventor of the microwave oven because she mentions experiencing the warming of her hand in the beam of the early radars. Good tech transfer usually results from someone making the connection between apparently unrelated phenomenon and proceeding from there. Author Alfred Koestler called it the act of creation, which he defined as "the bisociative synthesis between two random matrix elements to produce something new."

G. HARRY STINE

Good day, Dr. Schmidt:

I was interested in the amount of response elicited by Maya Kaathryn Bohnhoff's "Heroes" (09/90). And I'd especially like to follow up on Carl Steiger's comments (07/91).

What President Bush so parochially means when he says "new world order" is nothing like the truly-New truly-*World* Order that Ms. Bohnhoff is looking forward to. And no, she isn't using a crystal ball. Rather, she's using what I like to think of as the most up-to-date user's guide/procedures manual for living in today's world.

Her sources are no big secret. In fact, I suspect she'd be willing to share her "reading list" with anyone who asked—and, of course, SASEd—her. (For that matter, so would I; our libraries contain, I see, many of the same volumes. And while anyone can respond to such requests, I'd rather see Ms. Bohnhoff spend her time dropping *submissions* into the mailbox. May you receive and publish many of them.)

Like any good SF author, Ms. Bohnhoff is doing her research and her homework, then building her stories based on what can come from what already is. And I can't wait to see what she comes up with *after* she attends the 1992 World Congress. (I certainly hope she'll be there; what a wonderful way to spend the Thanksgiving weekend.)

My thanks to the whole *Analog* team for the good work you do. Keep on publishing the pieces that make us think.

LUCKI M. WILDER

7408 North Rogers
Chicago, IL 60626-1610

Dear Dr. Schmidt:

Although I like 'hard' science fiction (futuristic technology/space travel stories) as much as the next *Analog* reader, I occasionally grow tired of slogging through scientific jargon and excruciatingly detailed, multi-page descriptions of spacewalks and other technology-oriented tasks. As such, I particularly enjoyed Amy Bechtel's "Business As Usual" in the July 1991 *Analog*. Bechtel's piece was an intriguing, well-written bit of speculative fiction that was easy to read and did not require tempo-

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rary recalibration of the mind to accomodate futuristic settings, characters; or machines.

I sincerely hope Bechtel will write a third installment in this series. I also hope that more stories in a similar vein (by any author) will be forthcoming in the pages of *Analog*.

CHARLES MONSON
Iowa City, IA

Dr. Schmidt:

I didn't read the editorial in the July issue until long after I finished the stories, which is why this letter is so late. I agree with your premise and I think the time is near when direct-broadcast satellite transmissions will put the news beyond the control of any government. However, I think even the present situation is all to the good, in spite of George Will and not just due to an ingrained preference for truth over ignorance. It forces accountability on governments, something they aren't very used to and so complain loudly about. If a government can't convince people that a war is going to be worth the lives it costs, then maybe they are better off not fighting it. That's certainly preferable to starting a war and not finishing it, which is pretty much the worst of both worlds.

In fact, both studies of the Vietnam War and the recent Gulf War demonstrate that what most concerns the American public (at least) is incompetency. We are willing to accept deaths for a cause we believe in; we are not prepared to see them wasted to no purpose. It was the growing belief, not that the war was immoral but that it was being lost by incompetency that turned Americans against the War in Vietnam, at least according to one interesting study of opinion polls. Any student of military history must be struck by the tremendous amount of incompetency in war—most of it directly or indirectly coming from the politicians who run wars rather than the generals who have to carry out their demands. If the politicians know they are being judged by the voters, perhaps they will be a little more careful in making their decisions.

Of course, a lot of it will be public relations. It is difficult to judge military competency when we are seeing only a part of the story, and how competent are we to judge, in any case? Everybody knows, or can easily discover, exactly how many Americans and allies died in the Gulf War. But how about Iraqis? The only estimate I have seen that has made the least pretence to accuracy gave 100,000 dead. That is a sobering figure, but what I find even more sobering is how little press it gets. It is something to remember when we crow about how few were killed on our side in the war, and when we debate the next occasion to use force. There are good reasons to fight, and protecting the world from a would-be Hitler is certainly one of them, but that cannot disguise the true cost of war.

RICK PETERSON
12290 Corte Sabio #3208
San Diego, CA 92128

Dear Dr. Schmidt:

Your editorial "The Camera As Weapon" in the July 1991 issue illustrates a weakness that I find endemic among science fiction writers: the glorification of the role of technology in shaping the world while downplaying the importance of the sociohistorical. Technology, after all, is created and used by people, and people are fundamentally sociohistorical creatures.

There is some truth to your argument that modern technology (video cameras, satellite links, etc.) gives people access to information and images on what war

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is really like. But the structures of authority and control that limited our access to those images in Desert Shield and Storm were as old as the hills. Referring to the images of war, you say, "In many countries, citizens are not allowed by their own governments to see such things." Include the US in that condemnation, and the censorship of the media in Desert Shield predated the December 1990 preparation of your editorial.

President Bush's cry that we have finally shaken the "ghost of Vietnam" could be taken to mean that we finally realized that we should let the military do its work in secret rather than tell people too much about the reality of war. During Vietnam, the technology showed us the horror of war—piles of mangled bodies, traumatized American troops, and terrorized children who are the most helpless casualties of war. During Desert Storm, we saw high-tech pictures of highly glorified surgical strikes with laser guided bombs, but not the 50 mangled and tortured bodies in the building—mostly the bodies of poor saps like you and me who had no say in their own situation and would rather have been in another place at another time. We didn't see images of the tens of thousands of bodies of soldiers and civilians killed as they desperately tried to flee back to Iraq in what even the military admits was a turkey shoot.

The irony in all this is that many Americans—citizens of the land of the free—easily acquiesced to this propagandistic effort. They railed against Peter Arnett and CNN for submitting to Saddam's censorship but not to George's censorship.

Just as your editorial was about the future, so is this letter: How do we create a society in which people have access to the information they need to make considered decisions? How do we create a people that will not collude in their own delusion? The story is as old as history. Is there a future world in which it will be different? If so, it will not be technology that gets us there but rather new social, political, and moral structures.

THOMAS J. SULLIVAN
349 Lakewood Lane
Marquette, MI

Dear Sir

I read the science fact article, "Mars Direct," (July 1991) with great interest. As I do want colonies to be established there as soon as possible, I would like to have such a program succeed. However, I find one thing in the initial stage that bothers me. The article seems to assume that the initial unmanned lander has set up its nuclear plant, that it could produce huge amounts of methane and oxygen. According to my understanding of simple organic chemistry, ultimately six tons of hydrogen can produce 24 tons of methane.

If we do not find a local source of hydrogen such as Martian ice, that is the total methane produced.

However, it could produce much oxygen. I would appreciate if this quandry is cleared up for me. Otherwise, it looks to me that only polar regions can be explored at first.

PAUL NORLIE
Box 324
Fernley NV 89408

The author replies . . .

It is true that 6 tons of hydrogen produces 24 tons of methane. The methane, however, burns in combination with 84 tons of oxygen, which is also produced. The total propellant produced is thus 108 tons, or 18 times the mass of the hydrogen hauled from Earth. This is enormous leverage, and sufficient to en-

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able Mars Direct type missions to explore any site on the planet

ROBERT M. ZUBRIN

Dear Dr. Schmidt,

Zubrin & Baker's Mars Direct article in the July '91 issue dealt very well with the technological issues, but not so well with the bottom line. Specifically, they didn't justify how or where all this money will come from.

In short: Who's going to pay? And by what means? All Mars colonization plans call for billions of dollars and decades before the operation, hopefully, shows a profit. Presently, no private organization has this kind of capacity. Therefore, NASA must run it and the government must pay for it. However, it is highly questionable if even NASA is up to an epic challenge of this magnitude. Recently, Gregg Easterbrook's article "Space Lemons" (*The New Republic*, July 8, 1991) showed how NASA incompetence is keeping the space station Freedom on the ground, among other things.

Competence aside, on June 11 NBC evening news estimated the cost of going to Mars at 250 billion dollars. Cheap. The next day in the *San Diego Union* (page A-2) the cost was estimated at 400 to 500 billion (yes, *billion*—that wasn't a typo). I don't think Congress or the public is going to swallow that.

At this time our nation is facing many more urgent matters. The S&Ls, our national health care system, and the federal deficit are all examples of problems which will have to be solved here on Earth before we can talk about diverting our attention, and money, elsewhere.

There is still a widespread American interest is space. The recent solar eclipse made headline news. Thousands flew to Hawaii to get the best view of it. I believe there is support for space exploration as long as it's done at a reasonable price.

This nation has been capable of great accomplishments in the name of space exploration as Apollo and the space shuttle have proven. Our resources are second to none. If Mars exploration is to be accomplished at all, it will be done by America. But only if it is justified to the American public. Only with widespread public support will Congress spend the tens of billions that this epic project will demand.

Evidently widespread public support for a space project of this magnitude doesn't exist. I doubt the public will support it until someone comes up with a good reason why it should be done.

Can it be shown that this is the right thing to do?

A lot of effort has gone into showing that it is technologically feasible, but little has been expended to show that it is morally feasible.

Until recently, the most viable argument has been that Mars exploration should be undertaken by a multinational taskforce headed up by the United States and the Soviet Union. Whether such an alliance could have worked is debatable. However, recent events in the Soviet Union have made this argument obsolete.

The spinoff argument is another mirage. It states that the technology developed for space exploration has many uses here on Earth. Those uses will save enough money to pay for the original development. To a certain extent this is true. But I've never seen any article or book that proves that spinoffs even pay back the majority of development costs, much less all of it. NASA's own publication *Spinoff 1990* doesn't even assert, much less attempt to prove, the spinoff theory. The public won't be cajoled into

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space by this Trojan horse theory.

Justifying Mars exploration would seem to be very difficult. In fact, without a rational, bulletproof, totally correct argument I don't think we'll ever see *true and meaningful* exploration of Mars. It's possible that someday manned exploration of Mars could occur as a political stunt, like *Apollo*. But do we really want another one shot deal like *Apollo?*

After the *Apollo* Moon race was won, our nation lost interest. NASA, to this day, continues to exist only on bureaucratic inertia; stripped of any long-term goals to sustain it. "Onward to Mars!" has been touted as the next long-term goal for NASA since the days of Spiro Agnew. But, what for?

I think you'll agree that getting there is not as important as staying there. Whatever rationale that succeeds in getting a serious commitment to exploring Mars should also justify a permanent base, not just another "flagpole and footprints" extravaganza.

But it can be, and historically has been, done. Man has settled far away lands many times in the past for many different reasons.

The two things that you'll find in common with all successful colonizations is that they were justified on a cultural wide basis and accomplished with off-the-shelf technology. Not coincidentally, these two factors go hand in hand. Whatever the reasons for going, the venture must meet the test of being economically viable. Without being able to show a profit of some kind, the venture becomes a drain on the homeland's treasury; dependent on whomever controls the purse strings. Once the support fails, the strings are cut. The venture fades into memory as some one-time extravaganza or folly.

At this time Mars colonization isn't economically viable, but it may be some time in the future. But if that's the case, why bother going there to make a buck when there is money to be made here on Earth? And at less risk as well. Here's where the great reason for doing it all comes into focus. It must offer something that we can't have or can no longer have here on Earth. It must be valuable and economically accessible. Otherwise, why bother?

To this day, I have not seen such a reason. But that does not mean it doesn't exist. I think someday someone will find it. And when that happens . . . the rest will be just an engineering detail.

MARK W. HERBER
La Mesa, California ■

●The reason people blame things on previous generations is that there's only one other choice.

Doug Larson

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a calendar of analog upcoming events

5-8 March
WORLD HORROR CONVENTION II at Holiday Inn Crowne Plaza, Nashville, Tenn. Writer Guest of Honor—Richard Matheson, Media Guest of Honor—Richard Christian Matheson, Artist Guest of Honor—Harry O. Morris, MC—Brian Lumley, Registration—$75 attending, $25 supporting, Info: World Horror Convention, Box 22817, Nashville TN 37202. (615) 226-6172.

13-15 March
CRACKERCON (Jacksonville area SF conference) at Holiday Inn Baymeadows, Jacksonville, Fla. Guest of Honor—Mercedes Lackey, Artist Guest of Honor—Larry Dixon. Info: CrackerCon, Box 1509, Orange Park FL 32067-1509.

20-22 March
LUNACON '92 (NYC-area SF conference) at Rye Town Hilton, Rye Brook, N.Y. Writer Guest of Honor—Samuel R. Delany, Artist Guest of Honor—Paul Lehr, Fan Guest of Honor—Jon Singer. Registration—$25 until 22 February 1992, $35 at the door. Info: Lunacon '92, PO Box 338, New York NY 10150-0338.

20-22 March
NEOCON 3 (Kansas area SF conference) at Red Coach Best Western Inn, Wichita, Kans. Guest of Honor—Algis Budrys, Grand Pooh-Bah—Howard Waldrop, Art Guest of Honor—David Lee Anderson, Fan Guest of Honor—Leonard Bishop. Registration—$15 until 1 March, at least $18 at the door. Info: NeoCon 3, Box 48431, Wichita KS 67201. (316) 687-6424 [GEnie J.Bell 42. CompuServe 73537,452].

17-20 April
ILLUMINATION (43rd British National SF convention) at Norbreck Castle hotel, Blackpool. Guests of Honour—Paul McAuley and Geoff Ryman, Fan Guest of Honour—Pam Wells. Registration—£20 attending, £12 supporting. Info: Steve & Alice Lawson, 379 Myrtle Rd., Heeley, Sheffield S2 3HQ, England, U.K.

23-26 May
92nd A.B.A. Convention and Exhibition at the Hilton, Marriott and Convention Center, Anaheim, Calif. Open to the trade only. Info: American Booksellers Association, 137 West 25th St., New York NY 10001.

3-7 September
MAGICON (50th World Science Fiction Convention) at Orange County Civic & Convention Center, Orlando, Fla. Guest of Honor—Jack Vance; Artist Guest of Honor—Vincent Di Fate; Fan Guest of Honor—Walter A. Willis. Registration—$95 adult/$45 child until 31 March 1992; $110 adult/$55 child until 15 July 1992; $135 adult/$75 child at the door. Supporting—$25. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: MagiCon, Box 621992, Orlando, FL 32862-1992. (407) 275-0027. UK agent Peter Weston, 72 Beeches Drive, Erdington, Birmingham B24 ODT UK.

29 October-1 November
WORLD FANTASY CONVENTION at Callaway Gardens, Pine Mountain, Ga. Limited membership. Registration—$100 in advance. Info: World Fantasy Convention 92, Box 148, Clarkston GA 30021. (include SASE)

—Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices six months in advance of the event.

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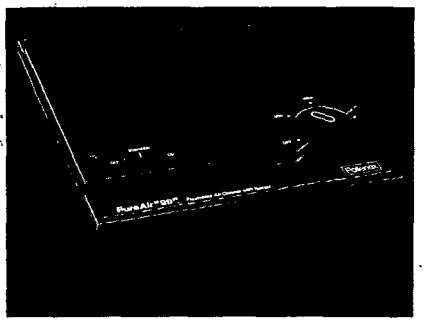

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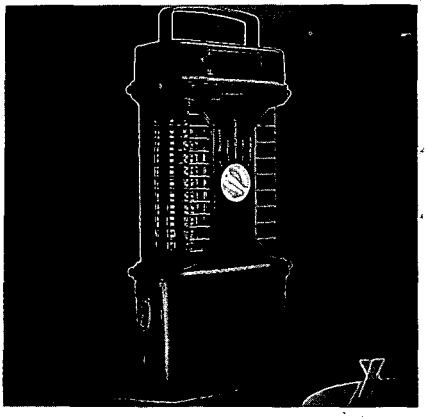

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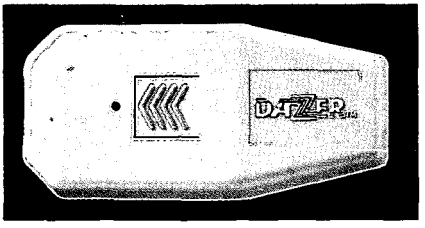

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